PUGSLEY'S NEW GUIDE

TO THE

United States Local Inspectors Examination

OF

Masters and Mates

OF

Ocean-Going Steam and Sailing Ships

CONTAINING ALL USEFUL INFORMATION

AND

Explaining How to Find Latitude and Longitude by Observation, and Many Other Useful Calculations not Included in the Examination

BY

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(LATE MASTER U. S. TRANSPORT SERVICE)

Author of "The Pilot," "How to Do the Work," "The Navigator," "Mariner's Guide," "Current-Course Projector," "Course Protractor," "Learner's Compass Card," "Course Corrector," Transparent Storm Cards, Distance-off Finder, etc.

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TABLE FOR CONVERTING POINTS INTO DEGREES AND THE CONTRARY

N. to E.	N. to W.	Pts.	° ′ ″	S. to E.	S. to W.
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NE. ¼ N.	NW. ¼ N.	3¾	42 11 15	SE. ¼ S.	SW. ¼ S.
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NE. ¾ E.	NW. ¾ W.	4¾	53 26 15	SE. ¾ E.	SW. ¾ W.
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PREFACE.

THIS work is not only a complete guide to the United States Local Inspectors Examination of Masters and Mates, a treatise on navigation, nautical astronomy and law of storms, but a valuable text-book for the student and a handy work for the navigator to use as a reference.

At present, no other work is published which contains an exact list of questions given by the Examiners.

In the preparation of this work no effort has been spared in making the problems as plain and simple as possible, and the methods used are the most reliable, and can be performed with any epitome of navigation; but for convenience, only that of Bowditch and no other has been used in working out the various examples.

A complete set of problems, all of which are for the 1902 almanac, and cover every requirement of the applicant for a license as third, second, first mate, or master of either sail or steam vessels, will be found in these pages.

The examinations for third, second and chief mate are the same.

Any applicant for a license as master or mate who writes the answers to the questions given him, so as to contain the substance of those given in these pages, and works out the problems in the form given herein, will obtain the desired certificate. Concerning the rules of road, the applicant should make a careful study, and it is suggested that he make several small models and place on them, in their proper positions, colored marks to represent the various lights. Two days' practice with these models placed in every possible position will be of more service than any set of questions and answers that could be written.

By the use of this volume any applicant may prepare himself for the examination, and by so doing save the enormous expense due to attending school.

An applicant for a license of any kind should not attend any school which does not guarantee in writing that he will not fail at the examination, and agrees also in writing to return his money to him in case of failure.

R. M. PUGSLEY.

LIST OF QUESTIONS

on the examination papers for master and mate. Where questions have two numbers, the second one refers to mate's examination paper, and the absence of such number indicates that the question does not apply to mates.

QUESTION 1, 1. What is latitude?

2, 2. Explain method of obtaining latitude by dead-reckoning?

3, 3. How do you proceed to find the latitude by a meridian observation of the sun?

4. How do you find the latitude by ex-meridian altitudes of the sun?

5. How do you find the latitude by a meridian observation of the moon?

6, 4. How do you find the latitude by an altitude of the pole-star?

7, 5. What is longitude?

8, 6. How do you obtain longitude by dead-reckoning?

9, 7. Explain the method of finding longitude by chronometer?

10. How do you find longitude from sunrise and sunset sights?

11. How do you find longitude by altitudes taken near noon?

12. Explain "Sumner's method"?

13, 8. How do you find course and distance?

14. Explain "plane sailing"?

15. Explain "middle latitude sailing"?

16. Explain "Mercator's sailing"?

17, 9. How do you detect an error in a quadrant or sextant?

18, 10. How do you adjust a quadrant?
19, 11. How do you adjust a sextant?
20, 12. What is polar distance?
13 (*mate only*). What is declination?
21, 14. What is zenith distance?
22. What is parallax?
23, 15. What is refraction?
24. What is right ascension?
25. What is radius?
26. What is the dip of the horizon?
27, 16. What is equation of time?
28, 17. What is apparent time?
29, 18. What is mean time?
30. What is sidereal time?
31. What is semi-diameter?
32. What is a meridian?
33. What is the ecliptic?
34, 19. What is an amplitude?
35. What is an angle?
36. What is an axis?
37, 20. What is an azimuth?
38. What are "diurnal motions"?
39. How are logarithms used?
40. What advantage is gained by their use?
41, 21. How can you find the variation of the compass by an amplitude?
42. What are the causes of local deviation of the compass?
43. How can you ascertain their extent?
44. How can you correct them?
45. What do you understand by "Mercator's chart"?
46, 22. How would you heave a steamer to in a gale?
47, 23. How would you heave a steamer to if machinery was disabled?
48, 24. Explain use and construction of a "drag"?

49. What method would you adopt to steer a ship if the rudder was lost or disabled?

50, 25. What are the fog-signals for a steamer under weigh?

51, 26. What are the fog-signals for sailing-vessels under weigh?

52, 27. What are the fog-signals for vessels at anchor?

53, 28. What are the lights for an ocean-steamer under weigh?

54, 29. What are the lights for a sailing-vessel under weigh?

55, 30. What are the lights for a towing-boat?

56, 31. What is the light for a vessel at anchor?

57. How do you obtain the bearing of the centre of a cyclone?

58. How would you manage to avoid the centre?

59. What motions has a cyclone?

60. What signal do you make for a pilot?

61, 32. What is a "bill of lading"?

62, 33. What is a manifest?

63. What is a protest?

64. What is a charter party?

65. What is a bottomry ?

66, 34. How do you mark a lead-line?

67, 35. How do you mark a log-line?

68, 36. What is the penalty when an officer of a steamer fails to keep the equipment in proper order?

69. What monthly report are you required by law to make to the United States Local Inspectors?

70, 37. What publications are required by law to be on board steamers and which are you compelled to allow passengers to use if called for?

71, 38. What are the duties of watchmen in passenger steamers and how many are required?

72, 39. How can you test a life-preserver?

73, 40. What notices regarding life-preservers are required and how many?

74, 41. Where are life-preservers to be located?

75, 42. How many life-preservers are required?

76, 43. Where does the law require the steam-whistle to be located?

77, 44. What is a station bill?

78, 45. How can you test fire hose and how would you keep it ready for use?

79, 46. What is the fire alarm?

80, 47. How often are fire and boat drills required by law?

81, 48. How does the law require woodwork around stoves, stovepipes, in lamp lockers, etc., to be protected?

82, 49. How often are you required to drill the crew in the use of the line carrying gun?

83, 50. What equipment does a lifeboat require by law?

84, 51. How must lifeboats be carried and overhauled?

85, 52. What equipment does a liferaft require by law?

86, 53. What would you do in case of fire?

87, 54. Describe size and construction of a fog bell.

88. When your vessel is to be hauled out, what report do you make and to whom?

89. How can you calculate the area of drag required by law for a steamer?

90, 55. What is astronomical time and date?

91. Explain method of obtaining latitude by meridian altitude of a fixed star.

92. Explain method of obtaining latitude by meridian altitude of a planet?

93. How can you find the approximate time of meridian passage of a fixed star?

94. How do you find which fixed star will be on the meridian?

95, 56. How can you find the time of high water when tide tables are not available?

96, 57. How can you find the distance off a fixed object by a four point bearing?

97, 58. How can you find the distance off a fixed object by a two point bearing?

98, 59. How can you find the distance off a fixed object by a one point bearing?

99, 60. How can you find the distance off a fixed object, the height of which is known?

100. What precautions would you take when making the land during thick or any bad weather?

101, 61. Explain the use of wave oil.

102. How would you allow for a current, the set and drift being known?

103. How can you convert statute miles into nautical miles?

104. What are your duties on joining a vessel as master?

105, 62. What would be your duty when relieving the officer in charge of the watch and while you are in charge of the watch?

106, 63. You being the officer in charge of a steamer or the officer detailed to accompany the United States Steamboat Inspector during the inspection of a vessel, what would be your duty?

107. What would you do in case of collision?

108. If your vessel was anchored near a shoal on either side, which way would you sheer the ship and why?

109. What is the penalty for blowing unnecessary whistles?

110, 64. What is the penalty for navigating a steamer beyond the waters called for in her certificate or the officer's license?

111, 65. What are the bell signals from the pilot-house to the engine-room?

112, 66. What is the penalty for flashing a searchlight into the pilot house of a passing vessel?

113, 67. What are the chief essentials that make an efficient compass?

114, 68. State the chief points to be considered when selecting a place for your compass on board ship and what must be particularly guarded against?

115, 69. Describe how you would stow a compass when out of use and why?

116, 70. What is leeway?

117, 71. What is compass error?

118, 72. What is variation of the compass and how do you find it?

119, 73. What is deviation of the compass?

120, 74. What is heeling error of the compass?

121, 75. What is a true bearing?

122, 76. What is a compass bearing?

123, 77. What is a magnetic bearing?

124, 78. What is a compass course?

125, 79. What is a true course?

126, 80. How can you find the deviation of the compass by altitude azimuths?

127, 81. How can you find the deviation of the compass by use of the azimuth tables?

128. How can you find the true bearing of the moon, planets, or fixed stars by use of the azimuth tables?

129, 82. How can you find the deviation of the compass by reciprocal bearings?

130, 83. How can you find the magnetic bearing of a distant fixed object and the deviation of the compass by equidistant bearings?

131, 84. What is the least distance the object should be from the ship to obtain the magnetic bearing accurately?

132, 85. How can you find the deviation of the compass while sailing along a coast?

133, 86. Name some of the objects by which you could obtain the deviation of the compass while sailing along a coast on which you are acquainted.

134, 87. To construct a deviation table is it necessary to bring the ship's head to more than one point and if so, state the reason?

135, 88. When swinging ship to construct a deviation table, what is the least number of points to which the ship's head should be brought?

136, 89. How often would you test the deviation table?

137, 90. Having found the deviation of the compass, how would you know if it is east or west?

138, 91. Under what conditions would you expect the deviation of the compass to change?

139. What effect do like and unlike poles of magnets have on each other?

140. On what courses would you expect the heeling error to be greatest and least?

141, 92. Explain the construction and use of a pelorus.

142, 93. What is a chart?

143, 94. Describe a Mercator chart.

144, 95. Where do you measure latitude on a Mercator chart?

145, 96. Where do you measure longitude on a Mercator chart?

146, 97. Where do you measure distance on a Mercator chart?

147, 98. What do the figures on the white surface indicate?

148, 99. What do the figures on the dark surface indicate?

149, 100. What do the figures on the land portion indicate?

150, 101. How would you know if the compasses on the chart are true or magnetic?

151. How would you correct a sounding for the height of tide above low water?

152, 102. How can you find a course and distance by chart?

153, 103. How can you find a vessel's position on a chart by cross bearings of two or more fixed objects which are shown on the chart?

154, 104. How would you prepare for receiving cargo?

155, 105. How would you use dunnage?

156, 106. How would you dunnage for guano?

157, 107. What is general cargo?

158, 108. How would you dunnage for a general cargo?

159, 109. How would you stow heavy weights in a general cargo?

160, 110. How would you stow railroad iron?

161, 111. How would you stow the first tier of casks?

162, 112. How would you stow the second tier of casks?

163, 113. How can you find the bung side of a cask in the dark?

164, 114. Why should casks be stowed bung up?

165. What is the capacity of a barrel, pipe, puncheon and hogshead?

166. How many tiers high would you stow casks?

167, 115. When stowing timber what would you be careful to avoid?

168, 116. How would you stow case and bale goods?

169, 117. Why would you stow bales on their edges in the wing?

170, 118. Where would you stow carboys of acids?

171, 119. Where would you stow tar, oil, rosin and other cargo of that nature in a general cargo?

172, 120. Where would you stow wines, liquors, etc.?

173, 121. When, where and what kind of petroleum is allowed as cargo in passenger steamers?

174, 122. What cargoes are most liable to spontaneous combustion?

175, 123. To what draught should a vessel be loaded?

176. Explain how you would load a ship in fresh or brackish water to have her proper draught in sea water.

177, 124. What precautions would you take when loading a ship in shallow water?

178, 125. What cargo is prohibited in passenger steamers?

179. How can you test the stability of a vessel?

180, 126. How can you find the safe working load for manila rope?

181, 127. What are the rules for steam vessels meeting end on?

182, 128. What are the rules for steam vessels crossing?

183, 129. What are the rules for steam and sail vessels meeting or crossing?

184, 130. What are the rules for a vessel overtaking another?

185, 131. What are the whistle signals for steamers in sight of each other?

186, 132. What is the rule for steam vessels in narrow channels?

187, 133. When one vessel must keep out of the way, what must the other one do?

188, 134. When you see a vessel forward of your beam and coming toward you, how would you know which vessel can safely cross the other or if danger of collision exists?

189, 135. When is a steam vessel a sail vessel within the meaning of the "rules of the road"?

190, 136. When is a vessel underway?

191, 137. What is the light for a vessel being overtaken?

192, 138. What are the rules for sailing vessels?

193, 139. When must a sailing vessel keep out of the way of a steamer?

194, 140. What are the signals for vessels not under command?

195, 141. What are the fog-signals for a steamer underway, but stopped?

196, 142. What are the signals for a vessel ashore in a fairway?

197, 143. What are the signals for a steamer under sail only with her funnel up?

198, 144. What are the signals for a vessel laying or picking up a telegraph cable?

199, 145. When can vessels not under command or vessels laying or picking up telegraph cables carry sidelights?

200, 146. If you were running before the wind and saw the red and green sidelights of a vessel right ahead, what would you do?

201, 147. Is there any reason why a steamer should not carry sail in foggy weather?

202, 148. Is there any reason why a sail vessel should not carry full sail in foggy weather?

203, 149. What are the distress signals?

204. You being in charge of a ship about ready to sail, what would be your duty?

ANSWERS TO THE QUESTIONS

on the examination paper for master, which must be written where the examination takes place. Where questions have two numbers, the second one refers to the mate's examination paper, and the absence of such number indicates that the question does not apply to mates. *Q.* means question, *Ans.* means answer.

Q. 1, 1. What is latitude? *Ans.* The distance any place is north or south of the equator, and is expressed in degrees, minutes and seconds.

Q. 2, 2. Explain method of obtaining latitude by dead-reckoning? *Ans.* After the courses have been corrected for leeway, deviation, variation, heave of the sea, bad steering, etc., enter them in a traverse table, and opposite each course their respective distances. Then from a table of latitude and departure, take out the difference of latitude corresponding to each course and distance, and place them in their respective columns. To the latitude left apply the difference of the sums of the two.

Q. 3, 3. How do you proceed to find the latitude by a meridian observation of the sun? *Ans.* Correct the observed meridian altitude for instrumental error, semi-diameter, dip, refraction and parallax. This subtracted from 90° gives the zenith distance which is named contrary to the sun's bearing. To the zenith distance add or subtract the sun's declination corrected for longitude, according if of same or different name. The latitude takes the name of the greater of the two.

Q. 4. How do you find latitude by ex-meridian altitudes of the sun? *Ans.* Observe an altitude near noon and apply the usual corrections. To the constant log. 0.29300 add the log. cosine of the latitude by account; log. cosine of the corrected declination, and the log. cosecant of the sum of the latitude by account and the corrected declination when these two quantities are of different name, and their difference when of the same name. The sum will be the log. of the change of altitude in one minute from noon. Multiply this number by the square of the time from noon to get the reduction. The remainder of the calculation is same as meridian altitude.

Q. 5. How do you find latitude by meridian observation of the moon? *Ans.* The same as meridian altitude of the sun, except that the declination must be corrected to the Greenwich minute of observation, and that a correction for parallax must be applied.

Q. 6, 4. How do you find the latitude by an altitude of the pole-star. *Ans.* Correct the altitude for instrumental error, dip and refraction. Turn the time of observation into sidereal time, and from it subtract the star's right ascension, and the remainder will be the hour angle. To the log. cosine of the hour angle add the log. of the polar distance in minutes. The logarithm thus found will give the correction in minutes to be subtracted from the altitude, except when the hour angle is more than 6 hours and less than 18 hours, when the correction is additive.

Q. 7, 5. What is longitude? *Ans.* It is the arc of the equator intercepted between the prime meridian and the meridian of any place.

Q. 8, 6. How do you find longitude by dead-reckoning? *Ans.* Correct the courses and enter them in traverse table the same as

for finding latitude by dead-reckoning, and from table of latitude and departure take out the corresponding departures and place them in their respective columns and take the difference of the two sums. Then enter table of latitude and departure with the middle latitude as a course, and find the departure made, in the latitude column, and the corresponding number in the distance column will be the difference of longitude which must be applied to the longitude left to get the longitude in.

Q. 9, 7. Explain method of finding longitude by chronometer? *Ans.* Observe an altitude of the body when on or as near the prime vertical as possible, and note the time by chronometer. Correct the altitude as usual, and apply the rate of the chronometer to the time noted, and correct the declination to the instant (Greenwich) of observation. From half the sum of the true altitude, latitude and polar distance, subtract the true altitude. Then add together the secant of the latitude, cosecant of the polar distance, cosine of the half sum and sine of the remainder. By Bowditch this resulting logarithm is divided by 2 to get the sine of apparent time; but if working by Thom, that operation is not performed. The time corresponding to this sine is the apparent time at ship when the observation was obtained. Correct the equation of time to the instant of observation (Greenwich) and apply it as directed to the local apparent time. The difference between the mean time of observation and that of Greenwich at the same instant is the longitude of the ship in time, and this is turned into degrees, etc.

Q. 10. How do you find longitude by sunrise and sunset sights? *Ans.* With a good glass observe the sun's limb to touch the horizon and note the time by chronometer. In this observation the altitude is a negative quantity and is found by adding the dip to the refraction for 0° and to the result add the semi-diameter if the upper limb is observed; but subtract if the lower limb is ob-

served. From the sum of the latitude by account and the polar distance subtract the negative altitude, divide the result by 2 and add the negative altitude to get the remainder. From here this calculation is performed the same as finding longitude by chronometer.

Q. 11. How do you find longitude by altitudes taken near noon? *Ans.* About as many minutes before noon as the ship is degrees of latitude from the equator, observe an altitude of the sun, note the time by chronometer and clamp the instrument. When the sun falls to the same altitude, again note the time by chronometer. Half the sum of these two times, after applying the rate and equation of time, will be the longitude in time, the time at ship being 0 h. 0 m. 0 s., or noon. If after taking the first altitude the ship changes her position by sailing toward the sun, the reading on the instrument must be increased the same number of minutes as the difference of latitude. If she has sailed from the sun, the second altitude must be decreased.

Q. 12. Explain Sumner's method? *Ans.* Observe an altitude noting the chronometer time, and apply the usual corrections. Assume two latitudes, one some 10 or 15 miles north of the latitude by account and another the same distance south of that position. Find the longitude in the usual way, using both latitudes, which will give two longitudes to be put on the chart in their respective latitudes, and connect the two positions by a line. About an hour later, or when the azimuth has changed about 20°. observe a second altitude and note the time as before, and work this observation in the same manner, and the result will be two more longitudes which are connected by a line. These two lines cross at a point called the ship's position. If the ship has sailed during the interval, the first line of position must be moved a corresponding distance on the same course.

Q. 13, 8. How do you find course and distance? *Ans.* By chart, or by plane, middle latitude or mercator sailings.

Q. 14. Explain plane sailing? *Ans.* The theory of this sailing is that the earth's surface is a plane, on which the degrees of latitude and longitude are everywhere equal.

Q. 15. Explain middle latitude sailing? *Ans.* Half the sum of the latitude left, and the latitude in, will give the middle latitude. With it enter table of latitude and departure as if a course. In the latitude column find the departure, and the corresponding number in the distance column will be the difference of longitude. The difference of longitude may be employed in similar manner to find the departure, and with that quantity and the difference of latitude, enter the table of latitudes and departures where they are found to agree, the number in the distance column will be the distance required, and the course is taken from the top or bottom of the table, according as the difference of latitude or the departure is the greater.

Q. 16. Explain Mercator's sailing? *Ans.* From a table of meridional parts take out the corresponding number for the latitude of each place. If the places are in latitude of same name, the difference of these two quantities will be the meridional difference of latitude; but when the latitudes are of different name, take their sum. Find this result and the difference of longitude to agree in a table of latitude and departure, taking the meridional difference of latitude in the latitude column and the difference of longitude in the departure column, which gives the course. The distance will be found opposite the proper difference of latitude on same page.

Q. 17, 9. How do you detect an error in a quadrant or sextant? *Ans.* By testing the adjustment.

Q. 18, 10. How do you adjust a quadrant? *Ans.* Move the vernier to about the middle of the arc, and if the true and reflected arcs in the index glass appear in an unbroken line, the index glass is perpendicular to the plane of the instrument. If the true and reflected arcs appear broken, the index glass must be adjusted by handling the screws. Now set the vernier at 0°, and holding the instrument face up, look through the horizon glass. If the true and reflected horizons appear in an unbroken line the adjustment is correct. Now hold the instrument in the ordinary position for observing altitudes, and if the true and reflected horizons show in an unbroken line, that adjustment is correct. If not in proper adjustment, it can be adjusted by handling the screws about the glass.

Q. 19, 11. How do you adjust a sextant? *Ans.* The same as a quadrant, except the telescope, which must be parallel to the plane of the instrument.

Q. 20, 12. What is polar distance? *Ans.* The angular distance any heavenly body is from the pole of the latitude of the observer.

Q. 13. This question for MATE ONLY. What is declination? *Ans.* The angular distance any heavenly body is from the plane of the equator.

Q. 21, 14. What is zenith distance? *Ans.* The angular distance any heavenly body is from the zenith (that point directly over the observer's head).

Q. 22. What is parallax? *Ans.* The difference between an altitude observed on the earth's surface and an imaginary one observed at the earth's centre.

Q. 23, 15. What is refraction? *Ans.* The angular distance any

heavenly body appears above its true place in the heavens. It is caused by the earth's atmosphere.

Q. 24. What is right ascension? *Ans*. It is the celestial longitude of a heavenly body reckoned from the first point of Aries entirely around the heavens toward the east, and is expressed in time.

Q. 25. What is radius? *Ans*. Half a diameter of a circle, or the distance from the centre to the surface of a sphere.

Q. 26. What is dip of the horizon? *Ans*. The angular distance an observer sees below the true horizon because of the elevation of his eye above the level of the sea.

Q. 27, 16. What is equation of time? *Ans*. The difference between mean and apparent time.

Q. 28, 17. What is apparent time? *Ans*. Time reckoned from the sun's passage over a meridian.

Q. 29, 18. What is mean time? *Ans*. Because of the form of the earth's orbit, the apparent solar day, or the interval of time between two successive passages of the sun over the same meridian, is not of uniform length, and varies with the seasons of the year. Mean time is the average length of the apparent solar day, and is that time shown by well-regulated chronometers and clocks.

Q. 30. What is sidereal time? *Ans*. A sidereal day is the interval of time between two successive passages of the same star over the same meridian.

Q. 31. What is semi-diameter? *Ans*. Half the diameter of anything; the sun, for instance.

Q. 32. What is a meridian? *Ans*. A semi-great circle passing from pole to pole, its plane cutting that of the equator at right angles.

Q. 33. What is the ecliptic? *Ans*. It is that great circle of the celestial concave which the sun seems to describe in its annual motion, or the earth's path around the sun.

Q. 34, 19. What is an amplitude? *Ans*. The angular distance any heavenly body when on the horizon is from the east or west points of the horizon.

Q. 35. What is an angle? *Ans*. The space lying between two lines not parallel.

Q. 36. What is an axis? *Ans*. The centre about which anything is supposed to revolve. The north and south poles of the earth are the extremities of its axis.

Q. 37, 20. What is an azimuth? *Ans*. The bearing of any heavenly body reckoned from the north point of the horizon east or west to 180° in north latitude; but from the south in south latitude.

Q. 38. What are diurnal motions? *Ans*. Daily revolution of any heavenly body on its axis.

Q. 39. How are logarithms used? *Ans*. For multiplying, dividing, extracting roots and raising numbers to any desired power, and for various other operations.

Q. 40. What advantage is gained by their use? *Ans*. They shorten and simplify mathematical calculations.

Q. 41, 21. How do you find the variation of the compass by an amplitude? *Ans.* When the sun is about its diameter above the horizon observe its bearing, note the course at the time, the amount of heel, and whether to port or starboard. The sum of the secant of the latitude and sine of the declination is the sine of the true amplitude reckoned from the east or west, and takes the name of the declination. The difference between the two bearings will be the compass error. When the compass bearing is to the left of the true bearing, the error is east; to the right, it is west.

Q. 42. What are the causes of local deviation of the compass? *Ans.* Iron and steel, of which the ship may be wholly or partly constructed, and like material in the cargo.

Q. 43. How can you ascertain their extent? *Ans.* By amplitude, azimuth, equidistant bearings, reciprocal bearings and by bearings of two known objects on shore when in range.

Q. 44. How can you correct them? *Ans.* By use of magnets.

Q. 45. What do you understand by Mercator's chart? *Ans.* On this chart the meridians are parallel and equidistant. The degrees of latitude are unequal, increasing in length toward the poles in the same proportion as the degrees of longitude are diminished on the globe, and the result is a plane chart.

Q. 46, 22. How would you heave a steamer to in a gale? *Ans.* The ordinary steamer will lay best with the sea 3 or 4 points on

the bow, with engines turning sufficient to give the vessel proper steerageway, and in case of very violent storms many ships would require a drag. Usually steamers will lay best with wind a point or so on the quarter. Righ handed propeller, wind on the starboard quarter. Left handed propeller, wind on the port quarter.

Q. 47, 23. How would you heave a steamer to if engines were disabled? *Ans*. By use of a drag or the propeller will act as a drag.

Q. 48, 24. Explain use and construction of a drag? *Ans*. There are several contrivances used for this purpose, and nearly every ship has on board a patent drag of some kind; but in case any of these are not at hand, and one is required, it must be constructed from such material as may be available. The best method for constructing one under such circumstances would be to take a spare spar and to it securely lash a quantity of timber, and weight the mass with kedge anchors, chains, etc., so that the timber will float even with the surface of the sea and not be exposed to the wind. Bridle the contrivance, and from the hawse-pipe lead a hawser to it, and after being well made fast, launch the whole affair, and allow sufficient scope of hawser. The idea of a drag is to keep the ship's head to the sea, and is made possible because the ship is exposed more to the wind than is the drag, and in consequence is inclined to drift the faster.

Q. 49. What method would you adopt to steer a ship if the rudder was lost or disabled? *Ans*. Circumstances and material at hand would in most cases suggest the method to be adopted; but in case of the rudder being not lost, but damaged so that it could not be used, it should be secured to prevent further damage. In case the rudder is lost and the necessary material is available, one should be constructed and shipped in its place, and when this is not possible, a float could be built, and one edge be buoyed by

spars, and the other weighted with chains, etc., that the contrivance may float on its edge. Have a good line from each quarter fast to it for towing, and from the after end have a line lead to each quarter, to which tackles can be attached and steer as with a rudder. Spare spars may be lashed together and towed in the same manner, but with a line to each quarter, so the spars can be hauled to either side and give the ship the desired sheer.

Q. 50, 25. What are the fog-signals for a steamer under way? *Ans.* A prolonged blast of the steam whistle at intervals of two minutes. With a tow, one long and two short blasts at intervals of two minutes.

Q. 51, 26. What are the fog-signals for sailing-vessels under way? *Ans.* At intervals of one minute on the starboard tack one blast of the fog-horn; port tack, two blasts in succession; and with the wind abaft the beam, three blasts in succession.

Q. 52, 27. What are the fog-signals for vessels at anchor? *Ans.* Ringing the ship's bell rapidly at intervals of one minute for about 5 seconds.

Q. 53, 28. What are the lights for an ocean-steamer under way? *Ans.* On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than 20 feet, and if the breadth of the vessel exceeds 20 feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than 40 feet, a bright white light, so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, namely, from right ahead to 2 points abaft the beam on either side, and of such a character as to be visible at a distance of at least 5 miles. On the starboard side a green light so constructed as to show an unbroken light

over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least 2 miles. On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side, and of such a character as to be visible at a distance of at least 2 miles. The said green and red side-lights shall be fitted with inboard screens projecting at least 3 feet forward from the light, so as to prevent these lights from being seen across the bow. A steam-vessel when under way may carry an additional white light. These 2 lights shall be so placed in line with the keel that one shall be at least 15 feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Q. 54, 29. What are the lights for a sailing-vessel under way? *Ans.* Side-lights the same as a steamer.

Q. 55, 30. What are the lights for a towing-boat? *Ans.* A steam-vessel when towing another vessel shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other, not less than 6 feet apart, and when towing more than one vessel shall carry an additional bright white light 6 feet above or below such light, if the length of the tow measuring from the stern of the towing-vessel to the stern of the last vessel towed exceeds 600 feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the masthead light, excepting the additional light, which may be carried at a height of not less than 14 feet above the hull. Such steam-vessel may carry a small white light abaft the funnel or aftermast for the vessel

towed to steer by, but such light shall not be visible forward of the beam.

Q. 56, 31. What is the light for a vessel at anchor? *Ans.* A vessel under 150 feet in length, when at anchor, shall carry forward, where it can best be seen, but at a height not exceeding 20 feet above the hull, a white light in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile. A vessel of 150 feet or upward in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than 20 and not exceeding 40 feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it shall be not less than 15 feet lower than the forward light, another such light.

Q. 57. How do you obtain the bearing of the centre of a cyclone? *Ans.* Face the wind, and in north latitude the centre will bear 8 points to the right. In south latitude face the wind, and the centre will bear 8 points to the left. Some authorities claim 10 points instead of 8, which is no doubt nearer the truth.

Q. 58. How would you manage to avoid the centre? *Ans.* In the Northern Hemisphere, heave-to on starboard tack if in the right semicircle; in the left semicircle run with the wind 2 points on starboard quarter, note the course, and keep it until out of danger. If the ship cannot run, heave-to on port tack. On the track in front of the storm, run before it, note the course, and keep it, and heave-to on port tack if necessary. In the rear of the storm, run with the wind 2 points on starboard quarter, or heave-to on starboard tack. In the Southern Hemisphere the rotary motion of these storms is contrary to those of the Northern Hemisphere, and the manœuvres would of course be contrary to those for the Northern Hemisphere.

Q. 59. What motions has a cyclone? *Ans*. Rotary and progressive.

Q. 60. What signal do you make for a pilot? *Ans*. Blue peter or jack on the fore, or use the code signal. During the night, flash a white light at short intervals, burn white—red—white Coston signal, or a blue light every 15 minutes.

Q. 61, 32. What is a bill of lading? *Ans*. A receipt for cargo received on board a ship and an agreement to deliver such goods at some port for a certain consideration. There are usually 3 of these documents, one for consignor, one for the consignee and one for the master, all signed by the master, owner or some authorized agent of the owner.

Q. 62, 33. What is a manifest? *Ans*. A list of the cargo, passengers, mail, stores and crew, with the names of the consignors and consignees, the name of the master, name of the ship and her tonnage and the ports of loading and discharging. There are not less than three copies, one of which is handed the boarding officer on arrival in port and is used for entering the ship at the Custom House.

Q. 63. What is a protest? *Ans*. A declaration made by the master of a ship before a notary, or consul if in foreign port, on arrival in port after a disaster, stating the particulars of same, and showing that the damage was not due to any fault of the vessel, her officers or crew, but to the perils of the sea, and protesting against them.

Q. 64. What is a charter party? *Ans*. An agreement in writing between the owner or master and the charterer that the vessel shall perform a certain service, for which her owners shall receive a certain consideration.

Q. 65. What is a bottomry? *Ans*. A contract by which the master or owner of a ship gives the vessel as security for money

loaned the ship to enable her to complete the voyage. No law regulates the interest on money loaned in this manner, and if the ship is afterward lost before completing the voyage the lender loses the money.

Q. 66, 34. How do you mark a lead-line? *Ans*. 2 fathoms, 2 strips of leather; 3 fathoms, 3 strips of leather; 5 fathoms, white rag; 7 fathoms, red rag; 10 fathoms, piece of leather with hole in it; 13 fathoms, blue rag; 15 fathoms, white rag; 17 fathoms, red rag; 20 fathoms, piece of leather with 2 holes in it, or piece of cod line with 2 knots.

After that every 10 fathoms marked with one additional knot, and such as 25, 35 and 45 fathoms are marked with one knot.

Q. 67, 35. How do you mark a log-line? *Ans*. By the proportion—3600s.:6080 ft.::A:X, in which A is the time glass and X the length of a knot. The length of a knot is as follows: For a 30s. glass, 50.66 feet; 28s. glass, 47.29 feet; 14s. glass, 23.64 feet.

Q. 68, 36. What is the penalty when an officer of a steamer fails to keep the equipment in proper order? *Ans*. His license may be suspended or revoked.

Q. 69. What monthly report are you required by law to make to the United States local inspectors? *Ans*. The number of passengers carried, dates and particulars of fire and boat drills and that the general condition of the vessel and equipment are as required by law. This report is not required for months during which the steamer is not navigated.

Q. 70, 37. What publications are required by law to be on board steamers and which are you compelled to allow passengers to use if called for? *Ans*. Pilot rules, notice excluding passengers from the pilot house or bridge, and at least two copies form 800, Laws Governing the Steamboat-Inspection Service. The last are to be

used by passengers if called for. Also three copies of section 50, Rule 5 of General Rules and Regulations.

Q. 71, 38. What are the duties of watchmen in passenger steamers and how many are required? *Ans.* Their duties are to prevent any unlawful act by any member of the crew or any passenger and in case of accident to alarm the passengers and assist them in the use of the life-saving appliances. One watchman is required in each cabin and steerage and report to the officer of the watch every half hour. Also a man on the lookout forward whose duty is to report all lights, vessels, etc., as they come in sight and also report the condition of the vessels running lights at regular intervals and perform no other duty while on the lookout.

Q. 72, 39. How can you test a life-preserver? *Ans.* Every life-preserver adjustable to the body of a person shall be made of good cork blocks or other suitable material approved by the Board of Supervising Inspectors, with belts and shoulder straps properly attached, and shall be so constructed as to place the device underneath the shoulders and around the body of the person wearing it. All such life-preservers shall be not less than 52 inches in length when measured laid flat; and every cork life-preserver shall contain an aggregate weight of at least 6 pounds of good cork, and every life-preserver shall be capable of sustaining for a continuous period of twenty-four hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life-preserver of at least 20 pounds. All life-preservers shall be covered with material of sufficient weight and strength to fully protect the contents, such material to be of a strength equivalent to unbleached cotton twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on each life-preserver shall be of one piece only, and the outside longitudinal edges of the covering at the seam must be turned to a roll and closely rope-stitched. Each life-preserver shall have two shoulder straps of heavy double-woven

cotton tape 1¼ inches in width. Each strap shall be made of one piece only, and such straps shall be not less than 23 inches net in length, and shall be securely attached to the covering of the life-preserver by not less than four rows of stitching and at not less than two places for each strap, the rear ends of the straps to be sewed on not less than 3 nor more than 5 inches from the center of the upper edge of the jacket, measured to the center of the straps. The said shoulder straps shall be securely attached to each other by not less than four rows of stitching at the point where they cross each other on the back, the forward end to be sewed on the jacket in such a position as to allow it to be opened out to its full length without straining the cross seizing. There shall also be on each life-preserver a breast or button strap of heavy double-woven cotton tape 1 inch wide and 12 inches long, one end of which shall be securely fastened to one shoulder strap by four rows of stitching at a point 4 inches above the jacket, and the other end of such breast strap shall be doubled back 2 inches and a buttonhole worked through both parts. A button of non-corrosive material shall be securely sewed on the other shoulder strap 4 inches above the jacket. There shall also be on each life-preserver a belt of heavy double-woven cotton tape 1¼ inches wide, extending along the middle line on the outside of the jacket, securely sewed to the covering of the life-preserver at not less than six places, the end blocks being left free, and the ends of the belt to extend 12 inches beyond the ends of the jacket. All thread used in the construction of life-preservers must be linen of a size and strength not less than Barbour's three-cord No. 25 machine thread. All seams and other machine sewing on life-preservers shall be with a short lock stitch, not less than 8 stitches to the inch. Every life-preserver must bear the stamp of the inspector with his initials and date and the name of the vessel, be in good condition and ready for use at all times.

Q. 73, 40. What notices regarding life-preservers are required and how many? *Ans*. There shall be a printed notice posted in

every cabin and stateroom and in conspicuous places about the decks, informing passengers of the location of life-preservers and other life-saving appliances, and of the mode of applying or adjusting the same.

Q. 74, 41. Where are life-preservers to be located? *Ans*. In the cabins, staterooms, berths and other places convenient for passengers, and when carried over head at a height greater than seven feet from the deck below efficient means must be provided for such immediate release and distribution, to be operated by persons standing on the deck below.

Q. 75, 42. How many life-preservers are required? *Ans*. One for each and every person allowed to be carried by the certificate of inspection.

Q. 76, 43. Where does the law require the steam whistle to be located? *Ans*. Not less than six feet above the top of the pilot house; but not higher than the top of the smokestack.

Q. 77, 44. What is a station bill? *Ans*. A list of the crew with their stations and duty in case of fire, collision or other accident. Station bills are to be posted in all parts of the vessel occupied or frequented by the crew.

Q. 78, 45. How can you test fire hose and how would you keep it ready for use? *Ans*. By applying a cold water pressure of 100 pounds and at all times keep at least one length of hose attached to each outlet of the fire main and provided with a suitable nozzle.

Q. 79, 46. What is the fire alarm? *Ans*. A continuous ringing of the ship's bell for a period of not less than 20 seconds, and this signal shall not be used for any other purpose whatsoever.

Q. 80, 47. How often are fire and boat drills required by law? *Ans*. At least once each week, weather permitting. Enter it in

the log-book with the time and date and report it once a month to the United States local inspectors with a statement of the general condition of the equipment and the vessel, using the form provided for that purpose, the drill to consist of calling all hands to quarters and exercising them in the clearing away and swinging out the boats and in the use of all other apparatus for the safety of life, with special regard for the drill of the crew in the method of adjusting life-preservers and educating passengers and others in this procedure and see that all the equipments required by law are in complete working order for immediate use.

Q. 81, 48. How does the law require woodwork around stoves, stovepipes, in lamp lockers, etc., to be protected? *Ans.* Stoves must be well secured so as to prevent them from being moved or be overthrown, and all woodwork about them and the stovepipes must be protected with metal, leaving an air space of one inch. Lamp lockers and other such places to be protected in the same manner.

Q. 82, 49. How often are you required to drill the crew in the use of the line-carrying gun? *Ans.* The master of every vessel equipped with a line-carrying gun shall drill his crew in the use thereof, and fire said gun at least once in every three months, using one-half the usual charge of powder and any ordinary line of proper length and see that these drills are entered on the log of the vessel.

Q. 83, 50. What equipment does a lifeboat require by law? *Ans.* All lifeboats shall have a properly secured life line the entire length on each side, and such line must be festooned with a seine float in each bight, the bights to be not longer than 3 feet; at least 2 life-preservers, 1 boat painter of not less than 2¾-inch manila rope, properly attached and of a suitable length; 1 rudder, with yoke and yoke ropes; 1 boat hook, and on wooden boats 2 plugs for each drain hole, attached with lanyard. Also a full

set of oars and rowlocks, 1 spare oar and rowlock, 1 steering oar, with rowlock or becket, 2 boat hooks, 1 bailer, 1 bucket; 1 lugsail, with sheet, tack, and reef earings, in a water-tight canvas bag; 1 mast and 1 yard, with necessary rigging, 1 boat compass, 1 lantern, 1 gallon can of illuminating oil, at least 1 box of matches wrapped in a waterproof package and carried in a box attached to the underside of the stern thwart, 1 breaker of fresh water of at least 15 gallons' capacity, 1 sealed tin containing 25 pounds of hard bread, 1 waterproof canvas bag 6 inches diameter and 15 inches long containing palm and needles, sail twine, marline, marline spike, hatchet, smoker's flint and steel, a small bottle of spirits of turpentine for priming lantern wicks and 6 night distress signals in a metallic case.

Q. 84, 51. How must lifeboats be carried and overhauled? ***Ans.*** All lifeboats shall be fitted with such davits and gear as will enable the boats to be safely launched in less than two minutes from the time the clearing away of the boats is begun. All lifeboats on vessels carrying passengers for hire must, if practicable, be carried under substantial davits or cranes; but if it is not practicable so to carry all the lifeboats required, the remainder must be stowed near at hand. All boats under davits must be arranged so that they can be simultaneously launched. Each lifeboat carried under davits must be provided with two separate davits. Such davits and the blocks and the falls thereof on all passenger vessels must be of sufficient strength to carry the boat with its full load. It shall be the duty of the master or officer in charge of all such vessels to see that the boat davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat davit falls on all boats not swung out at boat drills shall be cut adrift and overhauled; and it shall be unlawful to stow in any lifeboat articles other than those required by law and regulations. Lifeboats must be stripped, cleaned, painted, and thoroughly overhauled at least

once in every year. All lifeboats shall have their cubical contents painted on the stem in black letters and figures not less than three-fourths of an inch high on a white ground.

Q. 85, 52. What equipment does a liferaft require by law? *Ans*. All liferafts must be equipped with 2 life lines, securely fastened to the gunwales; 1 painter of 2¾-inch manila rope of a suitable length; not less than 4 oars of suitable size; 2 paddles, each of not less than 5 feet in length, the blade of each to be of not less area than one-half that of the blade of one of the oars of such raft; 4 rowlocks; 1 steering oar, with rowlock or becket, and 1 boat hook. Liferafts must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year.

Q. 86, 53. What would you do in case of fire? *Ans*. Call all hands to their stations and stretch the hose and get water on the fire as soon as possible after the fire is located, and then lay the vessel so that the fire will be to leeward. If the fire is in the hold, batten down the hatches as tight as possible and turn on the steam. If necessary also use water but pump it out if it can be done and is not needed in the bottom of the ship. Have boats and all other life-saving equipment ready for use at any moment, and get outside assistance if it can be obtained, and take advantage of the first opportunity to land the passengers if any. If the vessel can be beached or scuttled, do so where life can be saved and the vessel raised or hauled off at the least expense, but in enough water to put the fire out. Enter same in the log-book in full detail with time and date, and report it to the United States local inspectors.

Q. 87, 54. Describe the size and construction of a fog bell. *Ans*. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside, and constructed of bronze or brass or other material equal thereto in tone and volume of sound.

Q. 88. When your vessel is to be hauled out, what report do you make and to whom? *Ans.* Report to the United States local inspectors the place, time and date and the purpose for which the vessel is to be hauled out and the repairs intended.

Q. 89. How can you calculate the area of a drag required by law for a steamer? *Ans.* Steamers navigating the ocean must be provided with at least one drag, of area as follows: For steamers of 400 gross tons or under, not less than 25 superficial feet; for steamers of over 400 gross tons, the area of drag shall not be less than that determined by adding to 25 square feet 1 square foot for each additional 25 gross tons above 400 tons. This does not apply to steamers whose routes do not extend *off anchorage* are not required to have drags or floating anchors on board.

Q. 90, 55. What is astronomical time and date? *Ans.* It is the time past the last noon counted consecutively from 0h to 24h and the astronomical date corresponds to the civil date of the last noon.

Q. 91. Explain method of obtaining latitude by meridian altitude of a fixed star. *Ans.* Find the time of meridian passage and at that time observe the altitude and apply the usual corrections. Then find the zenith distance. Take the declination from the table of stars beginning on page 248 of the Nautical Almanac. The declination requires no correction. The latitude is then found the same as by meridian altitude of the sun.

Q. 92. Explain method of obtaining latitude by meridian altitude of a planet. *Ans.* Find the time of meridian passage and observe the altitude at that time and apply the usual corrections, the parallax being taken from table 17. The semi-diameter and horizontal parallax are found at the bottom of the proper page of the Nautical Almanac. Correct the declination for the time from Greenwich mean noon and apply it to the zenith distance in the usual way.

Q. 93. How can you find the approximate time of meridian passage of a fixed star? *Ans*. By subtracting the sun's right ascension from the star's right ascension the apparent time is found. To find the mean time of meridian passage, use the sidereal time from the last column on page II of the Nautical Almanac.

Q. 94. How can you find which fixed star will be on the meridian? *Ans*. Add the sun's right ascension to the local apparent time and the result will be the right ascension of the stars which will be on the meridian at that time. The sidereal time added to the local mean time gives the same result.

Q. 95, 56. How can you find the time of high water when tide tables are not available? *Ans*. Take the time of the moon's meridian passage from the Nautical Almanac and correct it for the longitude and to it add the establishment of the port. The result will be the approximate time of high water.

Q. 96, 57. How can you find the distance off a fixed object by a four point bearing? *Ans*. When the object is four points on the bow, note the log. When the object is abeam, note the log again. The distance run will be the distance off at the time of the second bearing.

Q. 97, 58. How can you find the distance off a fixed object by a two point bearing? *Ans*. Note the log when the object is abeam. When the bearing has changed two points note the log again. The distance run between the two bearings multiplied by 2.5 will be the distance off.

Q. 98, 59. How can you find the distance off a fixed object by a one point bearing? *Ans*. The same as by a two point bearing, except the distance run is multiplied by five.

Q. 99, 60. How can you find the distance off a fixed object, the height of which is known? *Ans*. Observe its altitude with a

sextant reading the angle to the nearest greater degree. Enter a table of difference of latitude and departure with the angle as if a course. Find the height of the object in the departure column and the corresponding number in the latitude column will be the distance off. The nearest greater degree is used because the lesser one would give a distance greater than the truth.

Q. 100. What precautions would you take when making the land during thick or any bad weather? *Ans.* During thick or bad weather sound the whistle as required by law, and when making the land have the anchors ready, look up the tides and currents and sound frequently and keep a good lookout. Run at moderate speed and if in a sailing vessel, have her under manageable sail. Listen for horns, bells, etc., and stop, anchor, or stand off shore if the position of the ship becomes too uncertain to run to pick up the light or other object intended to make. Also be sure the deviation of the compass is known and properly applied.

Q. 101, 61. Explain the use of wave oil? *Ans.* Saturate okum-filled bags with oil and it will leak out the holes in the bags made for that purpose. Running before the wind, oil bags should be towed from both catheads. The tow-line should be of such length as may be necessary to keep the bags in the water. Hove-to with or without a drag, an oil bag on the weather bow, one about mid-ships and one on the quarter will have a modifying effect. Also use an oil bag at any other part of the ship where the sea breaks.

Q. 102. How would you allow for a current, the set and drift being known? *Ans.* Lay off the course and the distance the ship will run in one hour. At the end of that line lay off the current and its drift per hour on the same side it comes from. Connect them with a line which will be the course to steer by compass to make good the course wanted, and the length of this line will be the distance to run by log to make good the speed for one hour.

Q. 103. How can you convert statute miles into nautical miles? *Ans.* By multiplying the number of statute miles by 1.152.

Q. 104. What are your duties on joining a vessel as master? *Ans.* Have my name indorsed on the papers at the Custom House. Inspect the vessel and her equipment, and if any defects are found have such repairs and alterations made as may be necessary, and if that cannot be done or if some considerable change is made, a report to the United States local inspectors would be necessary. Also take an inventory of the stores and see that the vessel is in proper condition, equipped, has the full complement of officers and crew and stored before going to sea. If possible obtain from the former master such vouchers and accounts as he may have, and if in a foreign port enter a list of them in the official log-book and both sign it.

Q. 105, 62. What would be your duty when relieving the officer in charge of the watch and while you are in charge of the watch? *Ans.* Inquire if any orders had been left and what they were, the course and if on a coast the time the ship passed the last light or prominent point, see that the running lights are showing properly and before he leaves the bridge look over the log and order-book. While in charge of the watch see that the proper course is being made, lookout on duty, watchmen in cabins and steerage during the night, that lights are showing properly, take an azimuth at least once, and when the course is changed, keep a good lookout and call the captain if the weather becomes thick, if a light is made unexpectedly, if soundings are not about what they are supposed to be or if in doubt about the safety of the ship in any way; but in any case call him in time.

Q. 106, 63. You being the officer of a steamer or the officer detailed to accompany the United States Steamboat Inspector during the inspection of the vessel, what would be your duty? *Ans.* All licensed officers shall assist the inspectors in their examination of any vessel to which such licensed officers belong, and shall

point out all defects and imperfections known to them in the hull, equipments, boilers, or machinery of such vessel.

Q. 107. What would you do in case of collision? *Ans.* Call all hands to quarters and get the life-saving equipment cleared away. At the same time sound the bilges, and if the vessel is making water and if possible pump it out and learn the extent of the damage. If the vessel is dangerously injured, beach her if possible where she can be hauled off or raised at the least expense. If that is not possible take to the boats and see that women, children and other passengers are first to leave the ship, the officers being last. Also take any other action to save life and property that the circumstances may permit. Enter a full account of the accident in the log-book with the time and date and report it to the nearest United States local inspectors on arrival in port. In every case of collision between two vessels it shall be the duty of the master or person in charge of each vessel, if and so far as he can do so without serious danger to his own vessel, crew, and passengers (if any), to stay by the other vessel until he has ascertained that she has no need of further assistance, and to render to the other vessel, her master, crew, and passengers (if any), such assistance as may be practicable and as may be necessary in order to save them from any danger caused by the collision and also to give to the master or person in charge of the other vessel the name of his own vessel and her port of registry, or the port or place to which she belongs, and also the names of the ports and places from which and to which she is bound. Every master or person in charge of a United States vessel who fails, without reasonable cause, to render such assistance or give such information as aforesaid shall be deemed guilty of a misdemeanor, and shall be liable to a penalty of one thousand dollars, or imprisonment for a term not exceeding two years.

Q. 108. If your vessel was anchored near a shoal on either side

which way would you sheer the ship and why? *Ans.* Toward the shoal because if she broke her sheer she would go from the shoal.

Q. 109. What is the penalty for blowing unnecessary whistles? *Ans.* The officer may be fined or his license may be suspended.

Q. 110, 64. What is the penalty for navigating a steamer beyond the waters called for in her certificate or the officer's license? *Ans.* His license may be suspended or revoked.

Q. 111, 65. What are the bell signals from the pilot house to the engine room? *Ans.* When engines are stopped, one bell—ahead slow. When engines are working ahead slow, jingle bell—full speed ahead. When engines are working full speed ahead, one bell—slow down. When engines are working ahead slow, one bell—stop. When engines are stopped, two bells—astern slow. When engines are working astern slow, jingle bell—full speed astern. When engines are working astern either slow or full speed, one bell—stop. When engines are working full speed ahead, four bells—astern. With jingle bell, full speed astern

Q. 112, 66. What is the penalty for flashing a searchlight into the pilot house of a passing vessel? *Ans.* The officer's license may be suspended or revoked.

Q. 113, 67. What are the chief essentials that make an efficient compass? *Ans.* It should have one or more light needles of strong directive force, the magnetic axis of which must be parallel to the north and south points of the card. The pivot should be hard and sharp. The cap is fitted with a finely finished agate or ruby that the card will be subjected to the least possible friction. The bowl is made of some non-magnetic substance. The complete compass is swung in gimbals. The edge of the card is divided into 4 quadrants, each of which are divided into 8 points, making a total of 32 points, which are subdivided to ½, ¼ and ⅛ points. The edge of the card is also divided into 360°, which are counted from

0° at north and south to 90° toward east and west. On the inside of the bowl one or more lübber's points are painted, usually four.

Q. 114, 68. State the chief points to be considered when selecting a place for your compass on board ship and what must be particularly guarded against? *Ans*. It should be placed in the middle line of the vessel at a height suitable for observations and of easy access, and as far as possible from any considerable mass of iron or steel. Vertical and movable iron or steel must be particularly guarded against.

Q. 115, 69. Describe how you would stow a compass when out of use and why? *Ans*. A compass should be stowed away bottom up to prevent wear of the pivot and agate.

Q. 116, 70. What is leeway? *Ans*. Leeway is the angle between the compass course and the direction the ship makes through the water.

Q. 117, 71. What is compass error? *Ans*. The difference between the ship's compass and the true compass. It includes the deviation.

Q. 118, 72. What is variation of the compass and how do you find it? *Ans*. The difference between the true and magnetic compasses. It is found on the chart.

Q. 119, 73. What is deviation of the compass? The difference between the ship's compass and the magnetic compass or the difference between the compass error and variation.

Q. 120, 74. What is heeling error of the compass? *Ans*. It is the difference between the deviation when the ship is upright and when she is heeled.

Q. 121, 75. What is a true bearing? *Ans*. A bearing free of variation and deviation.

Q. 122, 76. What is a compass bearing? *Ans*. A bearing by

compass. It includes the variation and deviation and heeling error if any.

Q. 123, 77. What is a magnetic bearing? *Ans.* A bearing including the variation.

Q. 124, 78. What is a compass course? *Ans.* The course steered by compass. It includes the variation and deviation, heeling error, current and leeway if any.

Q. 125, 79. What is a true course? *Ans.* A course corrected for variation, deviation, heeling error, leeway and current if any.

Q. 126, 80. How can you find the deviation of the compass by altitude azimuths? *Ans.* Observe an altitude, the bearing by compass of the body and note the time by chronometer at the same instant. The Greenwich time may be found by applying the longitude in time to the ship's time. Correct the declination and find the polar distance and correct the altitude in the usual way. Add together the polar distance, latitude by account and the true altitude. Then take the difference between the half sun and the polar distance. Take out the secant of the latitude, secant of the altitude, cosine of the half sun and cosine of the difference. These added together and divided by 2 gives the cosine of half the true azimuth and that multiplied by 2 gives the true azimuth. The difference between the true azimuth and the compass azimuth will be the compass error. If the true azimuth is to the left of the compass azimuth the error is west. To the right it is east. The deviation is the distance and direction from the variation to the compass error.

Q. 127, 81. How can you find the deviation of the compass by use of the azimuth tables? *Ans.* Observe the compass bearing of the body and take the true bearing from azimuth tables corresponding to the local apparent time and declination, noting if the latitude and declination are of same or different name. The remainder of the work is the same as by altitude azimuths.

Q. 128. How can you find the true bearing of the moon, planets or fixed stars by use of the azimuth tables? *Ans.* If the moon, star or planet is used, find the hour angle and with it enter the P.M. column of the azimuth tables and take out the bearing corresponding to it and the declination.

Q. 129, 82. How can you find the deviation of the compass by reciprocal bearings? *Ans.* One observer is ashore with a second compass where it is not influenced by iron, etc., and can be seen from the ship. The ship is then swung to each point of the compass and bearings by both compasses taken at the same instant by signal. The difference between the bearings by the shore compass reversed and the ship's compass will be the deviations for the points on which the ship's head was at the time of the bearings. Instead of taking a compass ashore a pelorus may be used by having the time and azimuth tables and by their use the pelorus may be set to correspond with the magnetic compass. This is the better method, as the danger of the shore compass having deviation is eliminated.

Q. 130, 83. How can you find the magnetic bearing of a distant fixed object and the deviation of the compass by equidistant bearings? *Ans.* The mean of the equidistant bearings of the object will be the magnetic bearing. The difference between the magnetic bearing and the compass bearings will be the deviation of the compass for each point her head was on.

Q. 131, 84. What is the least distance the object should be from the ship to obtain the magnetic bearing accurately? *Ans.* About six miles.

Q. 132, 85. How can you find the deviation of the compass while sailing along a coast? *Ans.* Take the compass bearing of any two known objects when in range. The difference between the magnetic bearing as found by the chart and the compass bearing will be the deviation.

Q. 133, 86. Name some of the objects by which you could obtain the deviation of the compass while sailing along a coast on which you are acquainted? *Ans.* Cape Ann lights, Cape Henry lighthouses, Fort San Juan and Mount Orizaba and any of the many ranges for entering harbors.

Q. 134, 87. To construct a deviation table is it necessary to bring the ship's head to more than one point and if so, state the reason? *Ans.* It is because the deviation is different for every point of the compass.

Q. 135, 88. When swinging ship to construct a deviation table, what is the least number of points to which the ship's head should be brought? *Ans.* Eight equidistant points.

Q. 136, 89. How often would you test the deviation table? *Ans.* As often as may be convenient or at least twice each watch and every time the course is changed if possible and when on any known bearings or ranges. Also swing the ship before entering a port and after leaving on at least the course intended to be used.

Q. 137, 90. Having found the deviation of the compass, how would you know if it is east or west? *Ans.* If the magnetic bearing is to the right of the compass bearing, the deviation is east. To the left it is west. If the true bearing is to the right of the compass bearing the compass error is east. To the left it is west. The deviation then is the distance from the variation to the compass error and is named after the direction from the variation to the compass error.

Q. 138, 91. Under what conditions would you expect the deviations of the compass to change? *Ans.* In a new iron ship, a great change of latitude, the ship being heeled, heavy shock as in seaway, being on one course for several days, at every change of course, alteration in the construction of the vessel, the ship being heated by a hot sun and particularly if painted black and one

side is exposed to the sun all day and if the smokestack is near the compass the deviation will change with the heat of it.

Q. 139. What effect do like and unlike poles of magnets have on each other? *Ans.* The north and south poles will attract each other. Two north or two south poles will repel each other.

Q. 140. On what course would you expect the heeling error to be greatest and least? *Ans.* Greatest on north and south courses and least on east and west courses.

Q. 141, 92. Explain the construction and use of a pelorus? *Ans.* A pelorus is a dumb compass swung in gimbals with a movable card. The instrument is set to correspond with the ship's compass and then the compass bearing of the sun or other body is observed with it instead of the compass.

Q. 142, 93. What is a chart? *Ans.* A projection, usually Mercator, on a map of a seacoast and a portion of the sea on which are shown the height of the land, depth of water, nature of the bottom, shoals, rocks or other dangers, aids to navigation, currents, data regarding tides, variation of the compass, anchorages, harbors, etc. It is made for the use of navigators.

Q. 143, 94. Describe a Mercator chart. *Ans.* This chart is a cylindrical projection, and constructed on the theory that the earth is a cylinder. The meridians are parallel to each other. The distances between the parallels of latitude are increased toward the poles in the same proportion that the meridians are expanded. All places are in their proper geographical positions and all courses and bearings are straight lines except the great circle track when between two ports not on the same meridian.

Q. 144, 95. Where do you measure latitude on a Mercator chart? *Ans.* On the graduated meridian at either side of the chart.

Q. 145, 96. Where do you measure longitude on a Mercator

chart? *Ans.* On the graduated parallel of latitude at the top or bottom of the chart.

Q. 146, 97. Where do you measure distance on a Mercator chart? *Ans.* On the graduated meridian at either side of the chart in the middle latitude.

Q. 147, 98. What do the figures on the white surface indicate? *Ans.* Soundings in fathoms.

Q. 148, 99. What do the figures on the dark surface indicate? *Ans.* Soundings in feet.

Q. 149, 100. What do the figures on the land portion indicate? *Ans.* Height of the land in feet.

Q. 150, 101. How would you know if the compasses on the chart are true or magnetic? *Ans.* The north and south line of a true compass is parallel to the meridians. The north and south line of a magnetic compass is not.

Q. 151. How would you correct a sounding for the height of tide above low water? *Ans.* Multiply the range in feet by the time from low water in hours and tenths and divide the product by the time the tide runs and add the result to the chart soundings or it may be subtracted from the depth obtained with the lead line.

Q. 152, 102. How can you find a course and distance by chart? *Ans.* The course is found by placing the edge of the parallel rules over the places between which the course is wanted. Then move them to the center of the nearest compass rose and read either the true or magnetic course. The inside compass is magnetic and outside one is true. After the course is found the rules should be moved back to prove it. It should be noticed if there are any obstructions on the course; also the depth of water. The tide wind and currents should be considered. The distance is found

by measuring with the dividers taking the miles from the graduated meridian at the side of the chart in the middle latitude of the places or on some charts (usually harbor charts) from a scale of miles. If the magnetic compass on the chart is used the deviation if any must be applied to produce the compass course. If the true compass is used the variation must also be used. A course protractor is more convenient for this purpose than the parallel rules, as it can be used where the chart cannot be opened as required to use parallel rules.

Q. 153, 103. How can you find a vessel's position on a chart by cross bearings of two or more fixed objects which are shown on the chart? *Ans.* Lay off the bearings on the proper side of the objects and the ship's position will be at the point where they cross.

Q. 154, 104. How would you prepare for receiving cargo? *Ans.* Clean and dry the hold, clear the limbers, scuppers, pump wells, peaks, etc. If the cargo is large leave the air strakes open. If fine close them with a batten. Have the dunnage clean and convenient for use. If the ship is to furnish any cargo gear, have it handy and in proper order.

Q. 155, 105. How would you use dunnage? *Ans.* Dunnage the floors, bilges, pump wells, masts, in the wake of the chain plates, scuppers, hooks and transoms. Lay dunnage fore and aft in the hold and athwartship in the between decks, leaving a water course on each side.

Q. 156, 106. How would you dunnage for guano? *Ans.* About 3 feet to the upper part of the turn of the bilge and about 6 or 8 inches in the sides and about 4 inches in the between decks.

Q. 157, 107. What is general cargo? *Ans.* A cargo composed of various manufactured articles of merchandise.

Q. 158, 108. How would you dunnage for a general cargo? *Ans*. Nine inches or more on the floors to 14 inches or more to the upper part of the turn of the bilges and 2½ inches or more in the sides and 2½ inches or more in the between decks. Dunnage is laid athwartship on top of water ballast tanks.

Q. 159, 109. How would you stow heavy weights in a general cargo? *Ans*. In the lower hold near the hatches and chock them well with dunnage and other cargo not easily injured.

Q. 160, 110. How would you stow railroad iron? *Ans*. Dunnage as high as the keelson, protect the sides from chafe and after stowing one tier solid, stow the rest grating fashion. Then dunnage off and tom down. If bags or other cargo is to be stowed on top of the iron, lay 2½ inches dunnage. A certain quantity of the iron should be stowed in the tween decks and tom it down also.

Q. 161, 111. How would you stow the first tier of casks? *Ans*. Begin amidship along the keelson and work fore and aft. Stow the casks bilge and cantline, bung up and bilge free with good beds at the quarters and quoins at the sides and chime to chime. Another way is to stow them bilge to bilge,

Q. 162, 112. How would you stow the second tier of casks? *Ans*. In the cantlines of the first tier and use some dunnage for the quoins on each side under the quarters to take on, to lessen the strain on the lower tier.

Q. 163, 113. How can you find the bung side of a cask in the dark? *Ans*. By the rivets in the hoops which are in line with the bung.

Q. 164, 114. Why should casks be stowed bung up? *Ans*. To prevent leakage and because the head pieces are vertical and therefore the cask is strongest in that position.

Q. 165. What is the capacity of a barrel, pipe, puncheon, and hogshead? *Ans*. Barrel about 45 gallons, pipe 126 gallons, puncheon 84 gallons and hogshead 63 gallons. A butt is the same as a pipe.

Q. 166. How many tiers high would you stow casks? *Ans*. Stow pipes 3 tiers, puncheons 4 tiers and barrels 8 tiers high.

Q. 167, 115. When stowing timber what would you be careful to avoid? *Ans*. The ends of the timber must be kept off the skin. and if the sides of the ship are very round a little dunnage may be necessary along the sides.

Q. 168, 116. How would you stow case and bale goods? *Ans*. The side of a case bearing the mark and number is the top and that side is stowed up. Bales are stowed on the flat amidships with marks and numbers up and on the edge in the wings with the marks and numbers in board.

Q. 169, 117. Why would you stow bales on their edges in the wing? *Ans*. That only a part of the bale would be damaged in case of leakage.

Q. 170, 118. Where would you stow carboys of acids? *Ans*. Well secured on deck, where they could be quickly thrown overboard in case of leakage.

Q. 171, 119. Where would you stow tar, oil, rosin and other cargo of that nature in a general cargo? *Ans*. Under and away from cargo that it might damage by leakage or odor. Also where it cannot leak into the limbers and pumpwells. If a large quantity is shipped the skin should be caulked.

Q. 172, 120. Where would you stow wines, liquors, etc.? *Ans*. Under other cargo that it may not be accessible during the voyage.

Q. 173, 121. When, where and what kind of petroleum is allowed as cargo in passenger steamers? *Ans*. Refined petroleum

which will not ignite at a temperature of less than 110° F. may, upon routes where there is no other practicable mode of transporting it, be carried on passenger steamers; but it shall not be lawful to receive on board or transport any petroleum unless the owner or master of the steamer shall have first received from the inspectors a permit designating the place or places on such steamer in which the same may be carried or stowed, with the further condition that the permit shall be conspicuously posted on the steamer. Refined petroleum must not in any case be received on board or carried unless it is put up in good iron-bound casks or barrels or in good metallic cans or vessels, carefully packed in boxes, and the casks, barrels, or boxes plainly marked on the heads thereof with the shipper's name, the name of the article, and the degree of temperature (Fahrenheit) at which the petroleum will ignite.

Q. 174, 122. What cargoes are most liable to spontaneous combustion? *Ans*. Cotton, jute, coal, rags, hemp, etc.

Q. 175, 123. To what draught should a vessel be loaded? *Ans*. The owner, agent, or master of every inspected seagoing vessel shall indicate the draft of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit, as indicated, shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate. The master of every seagoing vessel shall, whenever leaving port, enter the maximum draft of his vessel in the log, and the master shall be held responsible that the authorized draft is not exceeded.

Q. 176. Explain how you would load a ship in fresh or brackish water to have her proper draught in sea water. *Ans*. Draw a bucket of water from over the side and with the hydrometer find the specific gravity. Multiply 1028 by the proper sea water draught and divide the product by the specific gravity of the

water in which the ship is loaded and that will give the draught to which the ship should be loaded in that water.

Q. 177, 124. What precautions would you take when loading a ship in shallow water? *Ans.* Keep her on an even keel and afloat.

Q. 178, 125. What cargo is prohibited in passenger steamers? *Ans.* No loose hay, loose cotton, or loose hemp, camphene, nitroglycerin, naphtha, benzine, benzole, coal oil, crude or refined petroleum, or other like explosive burning fluids, or like dangerous articles, shall be carried as freight or used as stores on any steamer carrying passengers; nor shall gunpowder be carried on any such vessel except under special license; nor shall oil of vitriol, nitric or other chemical acids be carried on such steamers except on the decks or guards thereof or in such other safe part of the vessel as shall be prescribed by the inspectors; and oil or spirits of turpentine may be carried on such steamers when put up in good metallic vessels or casks or barrels well and securely bound with iron and stowed in a secure part of the vessel; and friction matches may be carried on such steamers when securely packed in strong, tight chests or boxes, the covers of which shall be well secured by locks, screws, or other reliable fastenings, and stowed in a safe part of the vessel at a secure distance from any fire or heat. Nothing in the foregoing or following sections of this Act shall prohibit the transportation by steam vessels of gasoline or any of the products of petroleum when carried by motor vehicles (commonly known as automobiles) using the same as a source of motive power: *Provided, however,* That all fire, if any, in such vehicles or automobiles be extinguished immediately after entering the said vessel, and that the same be not relighted until immediately before said vehicle shall leave the vessel: *Provided further,* That any owner, master, agent, or other person having charge of passenger steam vessels shall have the right to refuse to transport automobile vehicles the tanks of which con-

tain gasoline, naphtha, or other dangerous burning fluids. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin.

Q. 179. How can you test the stability of a vessel? *Ans.* Place a known weight on one side of the vessel and note the angle of heel. Place an equal weight the same distance from amidships on the same side and again note the angle of heel. If the second weight heeled the ship a less number of degrees than the first, the stability is good. If the same or more it is bad.

Q. 180, 126. How can you find the safe working load for manila rope? *Ans.* The square of the circumference of the rope divided by 10 gives the safe working load in tons.

Q. 181, 127. What are the rules for steam vessels meeting end on? *Ans.* When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other.

Q. 182, 128. What are the rules for steam vessels crossing? *Ans.* When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other. Every steam vessel which is to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Q. 183, 129. What are the rules for steam and sail vessels meeting or crossing? *Ans.* When a steam vessel and a sailing vessel are proceeding in such directions as to involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel, the sail vessel to keep her course.

Q. 184, 130. What are the rules for a vessel overtaking another? *Ans.* Notwithstanding anything contained in these rules, every vessel overtaking any other shall keep out of the way of

the overtaken vessel. Every vessel coming up with another vessel from any direction more than two points abaft her beam, that is, in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of that vessel's side lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear. As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel, she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

Q. 185, 131. What are the whistle signals for steamers in sight of each other? *Ans*. When vessels are in sight of one another, a steam vessel under way, in taking any course authorized or required by these rules, shall indicate that course by the following signals on her whistle or siren, namely: One short blast to mean, "I am directing my course to starboard." Two short blasts to mean, "I am directing my course to port." Three short blasts to mean, "My engines are going at full speed astern." The "short blast" means a blast of about one second's duration.

Q. 186, 132. What is the rule for steam vessels in narrow channels? *Ans*. In narrow channels every steam vessel shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on the starboard side of such vessel.

Q. 187, 133. When one vessel must keep out of the way, what must the other one do? *Ans*. Where one of two vessels is to keep out of the way the other shall keep her course and speed.

NOTE.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision cannot be avoided

by the action of the giving-way vessel alone, she also shall take such action as will best aid to avert collision.

Q. 188, 134. When you see a vessel forward of your beam and coming toward you, how would you know which vessel can safely cross the other or if danger of collision exists? *Ans*. Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

Q. 189, 135. When is a steam vessel a sail vessel within the meaning of the "rules of the road"? *Ans*. When under sail only and the funnel down.

Q. 190, 136. When is a vessel under way? *Ans*. A vessel is "under way" when she is not at anchor, or made fast to the shore, or aground.

Q. 191, 137. What is the light for a vessel being overtaken? *Ans*. A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel a white light or a flare-up light. The white light required to be shown may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon of twelve points of the compass, namely, for six points from right aft on each side of the vessel, so as to be visible at a distance of at least one mile. Such light shall be carried as nearly as practicable on the same level as the side lights.

Q. 192, 138. What are the rules for sailing vessels? *Ans*. When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other, as follows: A vessel which is running free shall keep out of the way of a vessel which is closehauled. A vessel which is closehauled on the port tack shall keep out of the way

of a vessel which is closehauled on the starboard tack. When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other. When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward. A vessel which has the wind aft shall keep out of the way of the other vessel.

Q. 193, 139. When must a sailing vessel keep out of the way of a steamer? *Ans.* When she is the overtaking vessel.

Q. 194, 140. What are the signals for vessels not under command? *Ans.* **A vessel which from any accident is not under command shall carry at the same height as a steamer's masthead light, where they can best be seen, and if a steam vessel in lieu of that light two red lights, in a vertical line one over the other, not less than six feet apart, and of such a character as to be visible all around the horizon at a distance of at least two miles; and shall by day carry in a vertical line one over the other, not less than six feet apart, where they can best be seen, two black balls or shapes, each two feet in diameter.**

Q. 195, 141. What are the fog signals for a steamer underway, but stopped? *Ans.* **A steam vessel under way, but stopped, and having no way upon her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between.**

Q. 196, 142. What are the signals for a vessel ashore in a fairway? *Ans.* **The same as for a vessel not under command, and the anchor light or lights. If foggy, use the bell.**

Q. 197, 143. What are the signals for a steamer under sail only, with her funnel up? *Ans.* **The same as for a vessel not under command.**

Q. 198, 144. What are the signals for a vessel laying or picking up a telegraph cable? *Ans.* **A vessel employed in laying or**

in picking up a telegraph cable shall carry in the same position as a steamer's masthead light and if a steam vessel in lieu of that light three lights in a vertical line one over the other not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all around the horizon, at a distance of at least two miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes not less than two feet in diameter, of which the highest and lowest shall be globular in shape and red in color, and the middle one diamond in shape and white.

Q. 199, 145. When can vessels not under command or vessels laying or picking up telegraph cables carry side lights? *Ans*. Only when making way through the water.

Q. 200, 146. If you were running before the wind and saw the red and green sidelights of a vessel right ahead, what would you do? *Ans*. The lights would be on a vessel in stays and as soon as I saw which way she payed off I would pass to windward of her. In a steamer it may be necessary to stop and back.

Q. 201, 147. Is there any reason why a steamer should not carry sail in foggy weather? *Ans*. The ship being supposed to be slowed in such weather the contention would rise that with sail set she was not slowed and also that she would not answer her helm so quickly, and in the event of collision the interests of the owners might be jeopardized.

Q. 202, 148. Is there any reason why a sail vessel should not carry full sail in foggy weather? *Ans*. A sailing vessel under full sail is going full speed, and in case of collision the owner's interests might be jeopardized.

Q. 203, 149. What are the distress signals? *Ans*. When a vessel is in distress and requires assistance from other vessels or

from the shore the following shall be the signals to be used or displayed by her, either together or separately, namely: In the day-time—First. A gun or other explosive signal fired at intervals of about a minute. Second. The international code signal of distress indicated by N. C. Third. The distance signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball. Fourth. A continuous sounding with any fog-signal apparatus. At night—First. A gun or other explosive signal fired at intervals of about a minute. Second. Flames on the vessel (as from a burning tar barrel, oil barrel, and so forth). Third. Rockets or shells throwing stars of any color or description, fired one at a time, at short intervals. Fourth. A continuous sounding with any fog-signal apparatus.

Q. 204. You being in charge of a ship about ready to sail, what would be your duty? *Ans.* To see that hatches, ports, etc., are properly secured, the cargo properly stowed, chain clear and anchors ready, lead lines properly marked and handy for use, steering gear, steam whistle, pumps, bell pulls or telegraph to the engine room, running lights are in good working order. Also that the entire equipment is complete, in satisfactory condition, that the crew is complete and that every member knows his station in case of fire, collision or other accidents, and that not more than the lawful number of passengers are on board. Have the vessel's draught and note that it does not exceed that given in the certificate. Also that the stores are complete and that compasses and binnacles are in good condition and that every other article, instrument and appliance required is on board, and before starting, that the propeller is clear. The ship is then ready for sea. Before sailing have every document required.

Q. 205, 150. Where would you stow heavy cargo in a river steamer? *Ans.* In the hold near a hatch amidship or on deck amidship not near any deck opening and well chocked off with other cargo not easily injured, such as bales. Heavy cargo should be carried on deck only in places well supported by stanchions.

Q. 206, 151. Where would you stow acids or matches? *Ans.* Matches may be carried on steamers when securely packed in strong, tight chests or boxes, the covers of which shall be well secured by locks, screws, or other reliable fastenings, and stowed on deck in a safe part of the vessel at a secure distance from any fire or heat. Acids should also be carried on deck, and both where they could be quickly thrown overboard in case of danger.

Q. 207, 152. How would you stow hay, straw, etc.? *Ans.* In bales on deck a safe distance from any fire or heat, covered with a tarpaulin and where it could be quickly thrown overboard in case of danger.

CALCULATIONS

which must be performed by masters and mates when being examined. Where examples have two numbers, the second one refers to the mates' examination, and the absence of such number indicates that the example does not apply to mates. The numbers correspond to those of the questions

2, 2. EXAMPLE: A ship had Highland Light bearing N. 67° W., distance 10 miles, ship's head S. 59° E., and then sailed the following courses and distances. Reverse the bearing and enter it in the traverse table, taking care that the deviation is for the ship's head. S. 59° E. 40 miles; S. 31° W. 32 miles; N. 47° W. 10 miles. Find the latitude. See example 8, 6.

TRAVERSE TABLE.

Compass Course.	Lee-way.	Var.	Dev.	Corrected Courses.	Dist.	Diff. Lat.		Dep.	
						N.	S.	E.	W.
S. 67° E.		9° W.	5° E.	S. 71° E.	10		3.3		
S. 59 E.		9 W.	4 E.	S. 64 E.	40		17.5		
S. 31 W.		9 W.	2 W.	S. 20 W.	32		30.1		
N. 47 W.		9 W.	5 W.	N. 61 W.	10	4.8			
						4.8	50.9 4.8		

Lat. left 40° 23′ 46″ N. Diff. lat. 46.1 S.
Diff. lat. 46 6 S.
Lat. in 39 37 40 N., which is latitude by dead-reckoning.

3, 3. **Example**: May 25, 1902. The observed meridian altitude of the sun's lower limb was 81° 56′ 30″ S. Height of eye 35 feet. Longitude by account 67° 30′ W. Find the latitude.

Obs. alt. L. L.	81° 56′ 30″ S.	Dec. N. A.	20° 49′ 46″.4 N.
Semi-diam. N. A.	+ 15 48	Cor.	+ 2 03 .8
	82 12 18	Cor. dec.	20 51 50 .2
Dip, table 14	− 5 48		
	82 06 30		
Ref. table 20	− 08		
	82 06 22	H. D. dec. N. A.	27″.51
Par. table 16	+ 02	Long. 67° 30′ W. = ×	4^h.5
True alt.	82 06 24		13755
	90 00 00		11004
Zen. dist.	7 53 36 N.	Cor. 2′ 03″.8	=123″.795
Cor. dec.	+20 51 50 N.		
Lat.	28 45 26 N.		

3, 3. **Example**: September 15, 1902. The observed meridian altitude of the sun's lower limb was 58° 12′ 30″ N. Height of eye 45 feet. Index correction +7′ 10″. Longitude by account 60° E. Find the latitude.

Obs. alt. L. L.	58° 12′ 30″ N.	Dec. N. A.	3° 17′ 42″.0 N.
I. C.	+ 7 10	Cor.	+ 3 50 .6
	58 19 40	Cor. dec.	3 21 32 .6
Semi-diam. N. A.	+ 15 56		
	58 35 36	H. D. dec. N. A.	57″.66
Dip, table 14	− 6 36	Long. 60° E. = ×	4^h
	58 29 00	Cor. 3′ 50″.6 =	230″.64
Ref. table 20	− 36		
	58 28 24		
Par. table 16	+ 04		
True alt.	58 28 28		
	90 00 00		
Zen. dist.	31 31 32 S.		
Cor. dec	− 3 21 33 N.		
Lat.	28 09 59 S.		

4. **Example**: July 4, 1902. Latitude by account 8° 56′ N. Longitude by account 60° 00′ E. The observed altitude of the sun's lower limb was 75° 10′ 10″ N. Time by chronometer $8^h\ 32^m\ 10^s$ A. M., and fast $11^m\ 08^s$. Height of eye 30 feet. Index correction +2′ 10″. Find the latitude.

Chro. time	$8^h\ 32^m\ 10^s$ A. M.
Fast	− 11 08
G. M. T.	8 21 02
Cor. equa. time	− 3 58
G. A. T.	8 17 04
Long. 60° E. =	+ 4 00 00
	12 17 04
	−12 00 00
Hour angle	17 04
Obs. alt. L. L.	75° 10′ 10″ N.
I. C.	+ 2 10
	75 12 20
Semi-diam. N. A.	+ 15 45
	75 28 05
Dip, table 14	− 5 22
	75 22 43
Ref. table 20	− 14
	75 22 29
Par. table 16	+ 02
True alt.	75 22 31
Cor.	+ 35 52
Mer. alt.	75 58 23
	90 00 00
Zen. dist.	14 01 37 S.
Cor. dec.	22 57 35 N.
Lat.	8 55 58 N.

Equa. of time N. A.	$3^m\ 59^s.82$
Cor.	− 1.69
Cor. equa. of time	3 58.13
H. D. equa. of time N. A.	$0^s.462$
$3^h\ 39^m$	= × $3^h.65$
	2310
	2772
	1386
Cor. $1^s.69$	= $1^s.68630$
Dec. N. A.	22° 56′ 49″.5 N.
Cor.	+ 45.2
Cor. dec.	22 57 34.7
H. D. dec. N. A.	12″.38
$3^h\ 39^m$	= × $3^h.65$
	6190
	7428
	3714
Cor. 45″.2	= 45″.1870
Change of alt. in 1^m	7″.36
Square of hour angle	× 292.41
	175446
	87723
	204687
Cor. for alt. 35′ 52″	= 2152″.1376

Constant		.29300	
Log.-cosine lat.	8° 56′ N.	9.99470	table 44
" " dec.	22 58 N.	9.96413	table 44
" cosecant lat. − dec.	14 02	.61531	table 44
Change of alt. in 1^m, 7″.36 = log.		.86714	table 42

Square of hour angle ($17^m\ 04^s$) = $17^m.1 \times 17^m.1$ = 292.41

4. Example: March 17, 1902. Latitude by account 40° 16′ N. Longitude by account 67° 30′ W. The observed altitude of the sun's lower limb was 48° 04′ 10″ S. Time by chronometer $4^h\ 59^m\ 07^s$ P. M., and fast $10^m\ 10^s$. Height of eye 39 feet. Index correction −4′ 30″. Find the latitude.

Chro. time	$4^h\ 59^m\ 07^s$ P. M.	Equa. of time N. A.	$8^m\ 43^s.12$
Fast	− 10 10	Cor.	− 3 .47
G. M. T.	4 48 57	Cor. equa. of time	8 39 .65
Cor. equa. time	− 8 40		
G. A. T.	4 40 17	H. D. equa. of time N. A.	$0^s.723$
Long. 67° 30′ W. =	−4 30 00	G. M. T. $4^h\ 48^m\ 57^s$	= × $4^h.8$
Hour angle	10 17		5784
			2892
		Cor. $3^s.47$	$=3^s.4704$

Obs. alt. L. L.	48° 04′ 10″ S.	Dec. N. A.	1° 36′ 05″.1 S.
I. C.	− 4 30	Cor.	− 4 44 .4
	47 59 40	Cor. dec.	1 31 20 .7
Semi-diam. N. A.	+ 16 05		
	48 15 45		
Dip, table 14	− 6 12	H. D. dec. N. A.	59″.25
	48 09 33	G. M. T. $4^h\ 48^m\ 57^s$ =	× $4^h.8$
Ref. table 20	− 52		47400
	48 08 41		23700
Par. table 16	+ 06	Cor. 4′ 44″.4	=284″.400
True alt.	48 08 47		
Cor.	+ 3 58		
Mer. alt.	48 12 45	Change of alt. in 1^m	2″.25
	90 00 00	Square of hour angle	× 106
Zen. dist.	41 47 15 N.		1350
Cor. dec.	− 1 31 21 S.		2250
Lat.	40 15 54 N.	Cor. for alt. 3′ 58″	=238″.50

Constant log		.29300	
Log.-cosine lat.	40° 16′ N.	9.88255	table 44
" " dec.	1 31 S.	9.99985	table 44
" cosecant dec. + lat.	41 47	.17632	table 44
Change of alt. in 1^m, 2″.25 = log.		.35172	table 42

Square of hour angle ($10^m\ 17^s$) = $10^m.3 \times 10^m.3$ = 106

5. EXAMPLE: January 26, 1902, A. M. The observed meridian altitude of the moon's lower limb was 59° 16′ 20″ S. Longitude by account 37° 30′ W. Height of eye 35 feet. Index correction +4′ 05″. Find the latitude.

Moon's mer. pass. 25th N. A.	$13^h\ 51^m.8$	H. D. pass. N. A.	$2^m.06$
Cor. for long.	+ 5 .1	Long. 37° 30′ W. = ×	$2^h.5$
L. M. T. mer. pass.	13 56 .9		1030
Long. 37° 30′ W.	= + 2 30 .0		412
G. M. T. mer. pass.	16 26 .9	Cor. for long. $5^m.1$ =	$5^m.150$

Obs. alt. L. L.	59° 16′ 20″ S.	Dec. N. A.	6° 02′ 36″.6 N.
I. C.	+ 4 05	Cor. for $26^m.9$ —	4 54 .0
	59 20 25	Cor. dec.	5 57 42 .6
Semi-diam. N. A.	+ 15 47		
	59 36 12		
Dip, table 14	— 5 48		
	59 30 24	M. D. dec. N. A.	10″.931
Ref. and par. table 24	+ 28 53		× $26^m.9$
True alt.	59 59 17 N.		98379
	90 00 00 N.		65586
Zen. dist.	30 00 43 N.		21862
Cor. dec.	+ 5 57 43 N.	Cor. 4′ 54″	=294″.0439
Lat.	35 58 26 N.		

5. EXAMPLE: November 14, 1902, P. M. The observed meridian altitude of the moon's lower limb was 49° 53′ 30″ N. Longitude 75° 00′ E. Height of eye 30 feet. Index correction —3′ 20″. Find the latitude.

Moon's mer. pass. N. A.	$11^h\ 04^m.9$	H. D. mer. pass. N. A.	$2^m.39$
Cor. for long.	— 11 .9	Long. 75° E. = ×	5^h
L. M. T. mer. pass.	10 53 .0	Cor. for long. $11^m.9$ =	$11^m.95$
Long. 75° E.	= — 5 00 .0		
G. M. T. mer. pass.	5 53 .0		

Obs. alt. L. L.	49° 53′ 30″ N.	Dec. at 6^h N. A.	13° 07′ 48″.7 N.
I. C.	— 3 20	Cor. for 7^m	— 1 00 .4
	49 50 10	Cor. dec.	13 06 48. 3
Semi-diam. N. A.	+ 16 22		
	50 06 32		
Dip, table 16	— 5 22		
	50 01 10	M. D. dec. N. A.	8″.632
Ref. and par. table 24	+ 37 46		× 7^m
True alt.	50 38 56	Cor. for 7^m 1′ 00″.4	=60″.424
	90 00 00		
Zen. dist.	39 21 04 S.		
Cor. dec.	—13 06 48 N.		
Lat.	26 14 16 S.		

6, 4. EXAMPLE: March 17, 1902. The observed altitude of the Pole Star was 38° 30′. Longitude by account 53° 30′ W. Local mean time 6^h 57^m P. M. Height of eye 26 feet. Index correction +2′ 10″. Find the latitude.

Obs. alt.	38° 30′ 00″	L. M. T.	6^h 57^m P. M.
I. C.	+ 2 10	Long. 53° 30′ W. =	+ 3 34
	38 32 10	G. M. T.	10 31 P. M.
Dip, table 14	— 5 00		
	38 27 10	L. M. T.	6^h 57^m 00^s
Ref. table 20	— 1 14	Sid. time N. A.	23 36 30
True alt.	38 25 56	Cor. for 10^h 31^m, table 9	1 44
Cor.	— 15 12		30 35 14
Lat.	38 10 44 N.	Reject 24^h	—24 00 00
		Local sid. time	6 35 14
		Star's right ascen. N. A.	— 1 23 24
		" hour angle	5 11 50
		Star's dec. N. A.	88° 47′ 04″
			90 00 00
		Star's pol. dist. 72′.9 =	1 12 56

Hour angle 5^h 11^m 50^s = 77° 57′ 30″ log. cosine	9.31937	table 44
Star's pol. dist. in miles 72′.9 log.	1.86273	" 42
Correction for alt. 15′.2 (15′ 12″) = log.	1.18210	" 42

6, 4. **Example**: October 3, 1902. The observed altitude of the Pole Star was 22° 33′ 00″. Local apparent time $5^h\ 30^m$ A. M. Longitude by account 63° 00′ E. Height of eye 35 feet. Find the latitude.

Obs. alt.	22° 33′ 00″	L. A. T. $5^h\ 30^m + 12^h = 17^h\ 30^m$		Oct. 2
Dip, table 14 −	5 48	Long. 63° E. =	− 4 12	
	22 27 12	G. A. T.	13 18	" 2
Ref. table 20 −	2 20			
True alt.	22 24 52			
Cor. −	25 09			
Lat.	21 59 43 N.	L. A. T.	$17^h\ 30^m\ 00^s$	
		Sun's right ascen. N. A.	12 32 40	
			30 02 40	
		Reject 24^h	−24 00 00	
		Local sid. time	6 02 40	
		Star's right ascen. N. A. −	1 23 24	
		" hour angle	4 39 16	
		Star's dec. N. A.	88° 47′ 04″	
			90 00 00	
		" pol. dist. 72′.9 =	1 12 56	

Hour angle $4^h\ 39^m\ 16^s$ = 69° 49′ log. cosine	9.53785	table	44
Star's pol. dist. in miles 72′.9 log.	1.86273	"	42
Correction for alt. 25′.15 (25′ 09″) = log.	1.40058	"	42

The following examples are worked by the method given in the Nautical Almanac, the necessary table being included here. The four problems cover all the conditions pertaining to this observation. Either of the two methods will be accepted by the examiner.

Example: September 8, 1902. The true altitude of the Pole Star out of the meridian was 41° 40′ 30″. Greenwich mean time $4^h\ 16^m$ A. M. Longitude by account 30° 19′ 15″ W. Find the latitude.

G. M. T.	$+12^h =$	$16^h\ 16^m\ 00^s$	Sept. 7
Long. 30° 19′ 15″ W.	$= -$	2 1 17	
L. M. T.	=	14 14 43	" 7

L. M. T.	$14^h\ 14^m\ 43^s$	Star's true alt.	41° 40′ 30″
Sid. time N. A.	11 02 31	Cor. Pole Star table	− 1 12 48
Cor. for $16^h 16^m$, table 9	2 40	Lat.	40 27 42 N.
	25 19 54		
	− 24 00 00		
Local sid. time.	− 1 19 54		
	1 24 06		
Star's hour angle	4 12		

EXAMPLE: October 27, 1902. Local mean time $10^h\ 40^m\ 30^s$ P. M. Longitude by account 29° 00′ E. The true altitude of the Pole Star was 43° 20′. Find the latitude.

L. M. T.		$10^h\ 40^m 30^s$
Long. 29° E.	$= -$	1 56 00
G. M. T.		8 44 30

L. M. T.	$10^h\ 40^m 30^s$	Star's true alt.	43° 20′ 00″
Sid. time N.A.	14 19 38	Cor. Pole Star table	− 1 12 27
Cor. for $8^h 44^m.5$, table 9	1 26	Lat.	42 7 33 N.
	25 01 34	This problem is from the 1902 N. A.	
	− 24		
	1 01 34		
	1 24 06		
Star's hour angle	22 32		

Table for Finding the Latitude by an Observed Altitude of Polaris taken from the Nautical Almanac for 1902.

Reduce the observed altitude of Polaris to the true altitude.

Reduce the recorded time of observation to the local sidereal time.

If the local sidereal time is
- less than $1^h\ 24.1^m$, subtract it from $1^h\ 24.1^m$;
- between $1^h\ 24.1^m$ and $13^h\ 24.1^m$, subtract $1^h\ 24.1^m$ from it;
- greater than $13^h 24.1^m$, subtract it from $25^h 24.1^m$;

and the remainder is the hour angle of Polaris.

With this hour angle take out the correction from Table IV (below), and add it to or subtract it from the true altitude, according to its sign. The result is the approximate latitude of the place.

TABLE IV—1902.

Hour Angle	0h	1h	2h	3h	4h	5h
m	° ′	° ′	° ′	° ′	° ′	° ′
0	−1 12.8	−1 10.2	−1 02.8	−0 51.0	−0 35.8	−0 18.2
5	1 12.8	1 09.8	1 02.0	0 49.9	0 34.4	0 16.7
10	1 12.7	1 09.3	1 01.1	0 48.7	0 33.0	0 15.1
15	1 12.6	1 08.8	1 00.2	0 47.5	0 31.6	0 13.5
20	−1 12.5	−1 08.3	−0 59.3	−0 46.3	−0 30.2	−0 12.0
25	1 12.4	1 07.7	0 58.4	0 45.0	0 28.7	0 10.4
30	1 12.2	1 07.1	0 57.4	0 43.7	0 27.2	0 08.8
35	1 12.0	1 06.5	0 56.4	0 42.4	0 25.7	0 07.2
40	−1 11.7	−1 05.8	−0 55.4	−0 41.1	−0 24.2	−0 05.6
45	1 11.4	1 05.1	0 54.3	0 39.8	0 22.7	0 04.0
50	1 11.0	1 04.4	0 53.2	0 38.5	0 21.2	0 02.5
55	1 10.6	1 03.6	0 52.1	0 37.2	0 19.7	−0 00.9
60	−1 10.2	−1 02.8	−0 51.0	−0 35.8	−0 18.2	+0 00.8

Hour Angle	6h	7h	8h	9h	10h	11h
m	° ′	° ′	° ′	° ′	° ′	° ′
0	+0 00.8	+0 19.6	+0 37.0	+0 51.8	+1 03.2	+1 10.4
5	0 02.4	0 21.1	0 38.4	0 52.9	1 04.0	1 10.8
10	0 04.0	0 22.6	0 39.7	0 54.0	1 04.7	1 11.2
15	0 05.5	0 24.1	0 41.0	0 55.1	1 05.4	1 11.5
20	+0 07.1	+0 25.6	+0 42.3	+0 56.1	+1 06.1	+1 11.8
25	0 08.7	0 27.1	0 43.5	0 57.1	1 06.7	1 12.0
30	0 10.3	0 28.6	0 44.8	0 58.1	1 07.3	1 12.2
35	0 11.9	0 30.0	0 46.1	0 59.0	1 07.9	1 12.4
40	+0 13.5	+0 31.4	+0 47.3	+0 59.9	+1 08.4	+1 12.5
45	0 15.0	0 32.8	0 48.5	1 00.8	1 08.9	1 12.6
50	0 16.6	0 34.2	0 49.6	1 01.7	1 09.4	1 12.7
55	0 18.1	0 35.6	0 50.7	1 02.5	1 09.9	1 12.8
60	+0 19.6	+0 37.0	+0 51.8	+1 03.2	+1 10.4	+1 12.8

8, 6. EXAMPLE: A ship had Fire Island Light bearing N. by E., 11 miles distant, variation 9° W., deviation 1° E., and was then sailed as follows in 24 hours:

Course.	Wind.	Leeway.	Var.	Dev.	Dist.
E. by N.	S. E.	½ pt.	9° W.	6° E.	17′
S. W. by W.	S.	½ pt.	9 W.	1 W.	40
E. by S.	S. S. E.	½ pt.	9 W.	5 E.	70
S. W. by S.	S. S. E.	½ pt.	9 W.	2 W.	53
S. E. by E.	S.	½ pt.	9 W.	4 E.	80
S.	S. E. by E.	½ pt.	9 W.	0	69

A current set N. N. E. magnetic throughout the 24 hours at the rate of 1¼ miles per hour.

Find the latitude and longitude in and course and distance made good, and then find the course and distance from that position to Gibbs Hill, Bermuda, by Mercator's sailing.

Fire Island Light.	Gibbs Hill Light.
Lat. 40° 37′ 57″ N.	Lat. 32° 15′ 05″ N.
Long. 73 13 08 W.	Long. 64 49 40 W.

TRAVERSE TABLE.

Compass Course.	Wind.	Lee-way.	Var.	Dev.	Dist.	Correct Courses.	Diff. Lat. N.	Diff. Lat. S.	Dep. E.	Dep. W.
S. by W.			9° W.	1° E.	11′	S. 3° W.		11.0		0.6
E. by N.	S. E.	½ pt.	9 W.	6 E.	17	N. 70 E.	5.8		16.0	
S.W. by W.	S.	½ pt.	9 W.	1 W.	40	S. 52 W.		24.6		31.5
E. by S.	S. S. E.	½ pt.	9 W.	5 E.	70	S. 88 E.		2.4	70.0	
S. W. by S.	S. S. E.	½ pt.	9 W.	2 W.	53	S. 28 W.		46.8		24.9
S. E. by E.	S.	½ pt.	9 W.	4 E.	80	S. 67 E.		31.3	73.6	
S.	S.E. by E.	½ pt.	9 W.	0	69	S. 3 E.		68.9	3.6	
N. N. E.			9 W.	0	30	N. 14 E.	29.1		7.3	
							34.9	185.0	170.5	57.0
								34.9	57.0	
								150.1	113.5	

Diff. lat. 150′.1 S.
Dep. 113.5 E. } = Course S. 37° E. Distance 188 miles.

Lat. Fire I. L.	40° 37′ 57″ N.		Long. Fire I. L.	73° 13′ 08″ W.	
Diff. lat.	2 30 06 S.		Diff. long.	2 26 00 E.	
Lat. ship	38 07 51 N.		Long. ship	70 47 08 W.	

Lat. Fire I. L. 40° 38′ N.
" ship 38 08 N.
2)78 46
Mid. lat. 39 23 = 39° dep. 113′.5 E. = diff. long. 146′ = 2° 26′ E.

Lat. ship	**38° 07′ 51″ N.**	**M. P. table 3**	**2464′.2**
" Gibbs H.	32 15 05 N.	" " 3	2033 .9
Diff. lat.	5 52 46 S.	Mer. diff. lat.	430 .3 S.

Long. ship	70° 47′ 08″ W.
" Gibbs H.	64 49 40 W.
Diff. long.	5 57 28 E.

Mer. diff. lat. 430′.3 S.
Diff. long. 5° 57′ 28″ = 357 .5 E. } = Course S. 40° E.

Proper diff. lat. 5° 52′ 46″ = 352′.8 = distance 460′.

9, 7. Example: January 18, 1902, A. M. The observed altitude of the sun's lower limb 14° 07′ 20″. Time by chronometer was 1^h 36^m 17^s P. M., and on September 25, 1901, was slow 16^m 10^s. and on October 9, 1901, was slow 14^m 09^s. After taking this observation the ship was sailed S. W. by S. 38 miles, variation 1° E., deviation 4° W., and then the observed meridian altitude of the sun's lower limb was 39° 10′ 20″ S. Longitude by account 79° 51′ W. Height of eye 30 feet. Index correction −2′ 10″. Find the latitude and longitude at the time of both observations, and from the noon position find the true course and distance by Mercator's sailing to Cape Canaveral in latitude 28° 27′ 37″ N. and longitude 80° 32′ 30″ W.

Chro. time	1^h 36^m 17^s P. M.	Sept. 25 slow	16^m 10^s
Slow Oct. 9	+ 14 09	Oct. 9 "	−14 09
	1 50 26	Gained 121^s	= 2 01
Gain in 101 days	− 14 33		
G. M. T.	1 35 53		

Daily rate gaining 8ˢ.64 = 121ˢ ÷ 14 days.
From Oct. 9, 1901, to Jan. 18, 1902 = 101 days.
Gain in 101 days = 101 days × (rate) 8ˢ.64.

Sept.	5 days
Oct.	+ 9 "
	14 "

Obs. alt. L. L.		14° 07′ 20″	
I. C	−	2 10	
		14 05 10	
Semi-diam. N. A.	+	16 17	
		14 21 27	
Dip, table 14	−	5 22	
		14 16 05	
Ref. table 20	−	3 44	
		14 12 21	
Par. table 16	+	09	
True alt.		14 12 30	

Dec. N. A.		20° 40′ 19″.4 S.
Cor.	−	47.9
Cor. dec.		20 39 31.5
	+	90 00 00.0
Pol. dist.		110 39 31.5

H. D. dec. N. A.	29″.97
G. M. T. = ×	1ʰ.6
	17982
	2997
Cor. 47″.9	= 47″.952

Equa. of time N. A.		10ᵐ 24ˢ.74
Cor.	+	1 .30
Cor. equa. of time		10 26 .04

H. D. equa. of time N. A.	0ˢ.812
G. M. T. = ×	1ʰ.6
	4872
	812
Cor. 1ˢ.30	= 1ˢ.2992

Obs. alt. L. L.		39° 10′ 20″	S.
I. C.	−	2 10	
		39 08 10	
Semi-diam. N. A.	+	16 17	
		39 24 27	
Dip, table 14	−	5 22	
		39 19 05	
Ref. table 20	−	1 11	
		39 17 54	
Par. table 16	+	07	
True alt.		39 18 01	
		90 00 00	
Zen. dist.		50 41 59	N.
Cor. dec.	−	20 37 32	S.
Lat. at noon		30 04 27	N.
Diff. lat. table 2	+	32 36	N.
Lat. at A. M. obs.		30 37 03	N.

Dec. N. A.		20° 40′ 14″.2 S.
Cor.	−	2 41 .9
Cor. dec.		20 37 32 .3

H. D. dec. N. A.	29″.99
Long. 79° 51′ W. = ×	5ʰ.4
	11996
	14995
Cor. 2′ 41″.9	161″.946

Compass Course.	Var.	Dev.	Dist.	True Course.	D. L.	DEP.
					S.	W.
S. W. by S.	1° E.	4° W.	38	S. 31° W.	32.6	19.6

Lat. at A. M. obs. 30° 37′ 03″ N.
" " noon 30 04 27 N.
2)60 41 30
Middle lat. 30 20 45 = 30° dep. 19′.6 W. = diff. long. 22′.6 W.

Alt. 14° 12′ 30″
Lat. 30 37 03 — Log. secant .06520
P. D. 110 39 31 — " cosecant .02886
2)155 29 04
½ sum 77 44 32 — " cosine 9.32698
Alt. 14 12 30
Rem. 63 32 02 — " sine 9.95192
(table 44)
2)19.37296

Local app. time 8ʰ 07ᵐ 28ˢ = Sine 9.68648 table 44
Equa. of time + 10 26 — 5ʰ = 75°
Local mean time 8 17 54 A. M. — 17ᵐ = 4 15′
G. M. T. 1 35 53 P. M. — 59ˢ = 14 45″
Long. in time 5 17 59 — Long. at A. M. obs. 79 29 45 W.
Diff. long. + 22 36 W.
Long. at noon 79 52 21 W.

Lat. noon 30° 04′ 27″ N. — M. P. table 3 1881′.5
" Cape C. 28 27 37 N. — " " 3 1772.0
Diff. lat. 1 36 50 S. — Mer. diff. lat. 109.5 S.

Long. noon 79° 52′ 21″ W.
" Cape C. 80 30 30 W.
Diff. long. 38 09 W.

Mer. diff. lat. 109′.5 S.
Diff. long. 38.1 W. } = Course S. 19° W.

Proper diff. lat. 1° 36′ 50″ = 96′.8 = dist. 102′.5

9, 7. EXAMPLE: September 9, 1902, A. M. The observed altitude of the sun's lower limb was 17° 10′ 40″. Time by chronometer was 11^h 15^m 07^s A. M., and on July 8 was fast 6^m 04^s, and on August 2 was fast 3^m 07^s. The sun's azimuth by compass was N. 109° 30′ E. After taking this observation the ship was sailed N. N. E. 34 miles, variation 8° W., deviation 7° W., and then the observed meridian altitude of the sun's lower limb was 61° 56′ 40″ S. Greenwich mean time 4^h 10^m P. M. Index correction + 4′ 20″. Height of eye 45 feet. Find the latitude and longitude at time of both observations, also the deviation of the compass.

Chro. time		11^h 15^m 07^s A. M.
Fast Aug. 2	—	3 07
		11 12 00
Lost in 38 days	+	4 29
G. M. T.		11 16 29

July 8 fast		6^m 04^s
Aug. 2 "		—3 07
Lost 177^s		=2 57

Daily rate losing $7^s.08 = 177^s \div 25$ days.
From Aug. 2 to Sept. 9 = 38 days
Lost in 38 days = 38 days × (rate) $7^s.08$

July	23 days
Aug. +	2 "
	25 "

Obs. alt. L. L.		17° 10′ 40″
I. C.	+	4 20
		17 15 00
Semi-diam. N. A.	+	15 56
		17 30 56
Dip, table 14	—	6 36
		17 24 20
Ref. table 20	—	3 05
		17 21 15
Par. table 16	+	08
True alt.		17 21 23

Dec. N. A.		5° 34′ 45″.1 N.
Cor.	+	39 .6
Cor. dec.		5 35 24 .7
		90 00 00 .0
Pol. dist.		84 24 35 .3

H. D. dec. N. A.	56″.52
Time from G. M. noon ×	$0^h.7$
Cor. 39″.6	=39″.564

Equa. of time N. A.		2^m $27^s.09$
Cor.	—	.60
Cor. equa. of time		2 26 .49

H. D. equa. of time N. A.	$0^s.854$
Time from G. M. noon ×	$0^h.7$
Cor. $0^s.60$	=.5978

Obs. alt. L. L.	61° 56′ 40″ S.		Dec. N. A.	5° 34′ 45″.1 N.
I. C.	+ 4 20		Cor.	− 3 57 .4
	62 01 00		Cor. dec.	5 30 47 .7
Semi-diam. N. A.	+ 15 56			
	62 16 56			
Dip, table 14	− 6 36			
	62 10 20		H. D. dec.	56″.52
Ref. table 20	− 31		G. M. T. 4^h 10^m = ×	$4^h.2$
	62 09 49			11304
Par. table 16	+ 04			22608
True alt.	62 09 53		Cor. 3′ 57″.4	=237″.384
	90 00 00			
Zen. dist.	27 50 07 N.			
Cor. dec.	+ 5 30 48 N.			
Lat. at noon	33 20 55 N.			
Diff. lat. table 2	− 33 42 S.			
Lat. at A. M. obs.	32 47 13 N.			

Compass Course.	Var.	Dev.	Dist.	True Course.	D. L.	DEP.
					N.	E.
N. N. E.	8° W.	7° W.	34	N. 7° E.	33.7	4.1

Lat. at noon	33° 20′ 55″	N.
" " A. M. obs.	32 47 13	N.
	2)66 08 08	
Middle lat.	33 04 04 = 33° dep. 4′.1 E. = diff. long. 4′.9 E.	

Alt.	17° 21′ 23″					
Lat.	32 47 13		Log. secant	.07537	table 44	
P. D.	84 24 35		" cosecant	.00207		
	2)134 33 11					
½ sum	67 16 35		" cosine	9.58691		
Alt.	17 21 23					
Rem.	49 55 12		" sine	9.88374		
				2)19.54809		
Local app. time	7^h 08^m 16^s =		Sine	9.77404	table 44	
Equa. of time	— 2 26					
Local mean time	7 05 50 A. M.			4^h = 60°		
G. M. T.	11 16 29 A. M.			10^m = 2 30′		
Long. in time	4 10 39			39^s = 9 45″		
			Long. at A. M. obs.	62 39 45	W.	
			Diff. long.	— 4 54	E.	
			Long. at noon	62 34 51	W.	

P. D.	84° 24′ 35″				
Lat.	32 47 13	Log. secant	.07535	table 44	
Alt.	17 21 23	" secant	.02022		
	2)134 33 11				
½ sum	67 16 35	" cosine	9.58678		
P. D.	84 24 35				
Diff.	17 08 00	" cosine	9.98029		
			2)19.66264		
½ true az.	47° 18′	= Cosine	9.83132	table 44	
	× 2				
True az.	N. 94 36 E.				
Com. "	N. 109 30 E.				
Com. error	14 54 W.				
Var. (chart)	8 00 W.				
Dev.	6 54 W.				

10. **Example**: July 7, 1902. The sun's lower limb was observed on the horizon at rising. Time by chronometer $9^h\ 32^m\ 05^s$ A. M., which was slow on June 14, $2^m\ 09^s$ and gaining $2^s.4$ daily. Latitude by account 38° 03′ N. Height of eye 40 feet. Find the longitude at time of observation and the course and distance by Mercator's sailing to Sandy Hook lightship in latitude 40° 28′ N., and longitude 73° 50′ W.

Ref. alt. 0° table 20		36′ 29″
Dip, table 14	+	6 12
		42 41
Semi-diam. N. A.	−	15 45
		26 56
Par. table 16	−	09
Neg. alt.		26 47

Chro. time		$9^h\ 32^m\ 05^s$ A. M.	June		16 days
Slow June 14	+	2 09	July	+	7 "
		9 34 14			23 "
Gain in 23 days	−	55	Rate	×	$2^s.4$
G. M. T.		9 33 19			92
					46
					$55^s = 55.2$

Dec. N. A.	22° 40′ 10″.6 N.	H. D. dec. N. A.		15″.36
Cor.	+ 36 .9		×	$2^h.4$
Cor. dec.	22 40 47 .5			6144
	90 00 00 .0			3072
Pol. dist.	67 19 12 .5	Cor. 36″.9	=	36″.864

Equa. of time N. A.	$4^m\ 31^s.60$	H. D. equa. of time N. A.		$0^s.419$
Cor.	− 1 .00		×	$2^h.4$
Cor. equa. of time	4 30 .60			1676
				838
		Cor. $1^s.00$	=	$1^s.0056$

Lat.	38° 03′ 00″	Log. secant	.10376
P. D.	67 19 12	" cosecant	.03495
	105 22 12		
Neg. alt.	− 26 47		
	2)104 55 25		
½ sum	52 27 42	" cosine	9.78482
Neg. alt.	+ 26 47		
Rem.	52 54 29	" sine	9.90183
			2)19.82536
	$4^h\ 41^m\ 04^s$ = Sine		9.91268

Tab. cor.	− 02	
Local app. time	4 41 02	$4^h = 60°$
Equa. of time	+ 4 31	47^m = 11 45′
Local mean time	4 45 33 A. M.	44^s = 11 00″
G. M. T.	9 33 19 A. M.	Long. 71 56 00 W.
Long. in time	4 47 44	

Lat. ship	38° 03′ 00″ N.	M. P. table 3	2457′.9
" S. H. L. S.	40 28 15 N.	" " 3	2644.5
Diff. lat.	2 25 15 N.	Mer. diff. lat.	186.6 N.

Long. ship	71° 56′ 00″ W.
" S. H. L. S.	73 50 09 W.
Diff. long.	1 54 09 W.

Mer. diff. lat. 186′.6 N.
Diff. long. 1° 54′ 09″ = 114.1 W. } = Course N. 32° W.

Proper diff. lat. 2° 25′ 15″ = 145′.2 = dist. 171′.

10. EXAMPLE: December 9, 1902. The sun's upper limb was observed on the horizon at setting. Time by chronometer $11^h\ 32^m\ 22^s$ P. M., and on Nov. 9 was fast $0^m\ 31^s$ and losing $1^s.2$ daily. Latitude by account 21° 10′ N. Height of eye 35 feet. Find the longitude at time of observation and the course and distance by middle latitude sailing to Vera Cruz in latitude 19° 12′ N. and longitude 96° 08′ W.

Ref. alt. 0° table 20	36′ 29″
Dip, table 14	5 48
Semi-diam. N. A.	16 16
	58 33
Par. table 16	− 9
Neg. alt.	58 24

Chro. time	$11^h\ 32^m\ 22^s$ P. M.	Nov.	21 days
Fast Nov. 9	− 31	Dec.	9.5 "
	11 31 51		30.5 "
Lost in 30 days +	37	Rate	× $1^s.2$
G. M. T.	11 32 28		610
			305
		37^s	$=36^s.60$

Loss in 30.5 days = 30.5 days × (rate) $1^s.2$

Dec. N. A.	22° 45′ 50″.2	H. D. dec. N. A.	15″.36
Cor.	+ 2 56 .6	G. M. T.	× $11^h.5$
Cor. dec.	22 48 46 .8		7680
	90 00 00 .0		1536
Pol. dist.	112 48 46 .8		1536
		Cor. 2′ 56″.6	=176″.640

Equa. of time N. A.	$7^m\ 50^s.99$	H. D. equa. of time N. A.	$1^s.107$
Cor.	− 12 .73	G. M. T.	× $11^h.5$
Cor. equa. of time	7 38 .26		5535
			1107
			1107
		Cor. $12^s.73$	$=12^s.7305$

Lat.	21° 10′ 00″	Log. secant	.03034	table 44
P. D.	112 48 47	" cosecant	.03537	table 44
	133 58 47			
Neg. alt. −	58 24			
	2)133 00 23			
½ sum	66 30 11	" cosine	9.60065	table 44
Neg, alt. +	58 24			
Rem.	67 28 35	" sine	9.96554	table 44
			2)19.63190	
	$5^h\ 27^m\ 04^s$ = Sine		9.81595	table 44

Tab. cor.	+ 01		
Local app. time	5 27 05	6^h =	90°
Equa. of time	− 7 38	13^m =	3 15′
Local mean time	5 19 27 P. M.	1^s =	0 15″
G. M. T.	11 32 28 P. M.	Long.	93 15 15 W.
Long. in time	6 13 01		

Lat. ship	21°	10′	00″	N.	Long. ship	93°	15′	15″	W.
" V. C.	19	12	00	N.	" V. C.	96	08	00	W.
Diff. lat.	1	58	00	S.	Diff. long.	2	52	45	W.

Lat. ship 21° 10′ N.
" V. C. 19 12 N.
2)40 22
Mid. lat. 20 11 = 20° diff. long. 172′.7 = dep. 162′.6 W.

Diff. lat. 118′.0 S.
Dep. 162 .6 W. } = Course S. 54° W. Dist. 201′.

11. EXAMPLE: July 8, 1902. The following equal altitudes of the sun were observed and the times noted by chronometer.

Altitude A. M. 74° 12′ Time by chronometer $4^h\ 06^m\ 08^s$ P. M.
" P. M. 74 12 " " " 4 37 16 P. M.

1st alt.	$4^h\ 06^m\ 08^s$ P. M.	Equa. of time N. A.	$4^m\ 41^s.48$
2d "	4 37 16 P. M.	Cor. +	1 .77
	2)8 43 24	Cor. equa. of time	4 43 .25
G.M.T. of L.A. noon	4 21 42 P. M.		
Equa. of time	— 4 43	H. D. equa. of time	$0^s.403$
G.A.T. of L.A. noon	4 16 59 P. M.	G. M. T.	$4^h.4$
			1612
			1612
		Cor. $1^s.77$	$=1^s.7732$

4^h = 60°
16^m = 4 00′
59^s = 14 45″
Long. 64 14 45 W.

11. EXAMPLE: October 20, 1902. The observed altitude of the sun's lower limb was 39° 58′ east of the meridian. Time by chronometer $3^h\ 40^m\ 06^s$ P. M. When the same altitude was observed west of the meridian, the time by chronometer was $4^h\ 02^m\ 17^s$ P. M. Chronometer was slow $4^m\ 16^s$.

1st alt. chro. time	$3^h\ 40^m\ 06^s$ P. M.	Equa. of time N.A.	$15^m 00^s.65$
2d " " "	4 02 17 P. M.	Cor.	+ 1 .73
	2)7 42 23	Cor. equa. of time	15 02 .38
	3 51 11.5		
Chro. slow	+ 4 16.0		
G.M.T. of L.A. noon	3 55 27.5 P. M.	H. D. equa. of time	$0^s.445$
Equa. of time	+ 15 02.4	G. M. T.	× $3^h.9$
G.A.T. of L.A. noon	4 10 29.9 P. M.		4005
			1335
		Cor. $1^s.73$	$=1^s.7355$

$4^h = 60°$
$10^m = \ \ 2\ 30'$
$30^s = \ \ \ \ 7\ 30''$
Long. 62 37 30 W.

12. EXAMPLE: July 1, 1902, A. M. The observed altitude of the sun's lower limb was 12° 44′ 10″. Time by chronometer $10^h\ 39^m\ 12^s$ A. M. The ship was then sailed west (true) 12 miles, and the observed altitude of the sun's lower limb was 43° 10′ 20″. Time by chronometer $1^h\ 10^m\ 04^s$ P. M. Latitude by account at time of first observation was 35° 00′ N. Height of eye 40 feet. Assume latitudes about 15 miles each side of that by account. Find the summer lines and project them on the chart and show the ship's position at time of both observations and the sun's true azimuth.

Obs. alt. L. L.	12° 44′ 10″	Dec. N. A.	23° 09′ 52″.6 N.
Semi-diam. N. A.	+ 15 45	Cor.	+ 12 .2
	12 59 55	Cor. dec.	23 10 04 .8
Dip, table 14	− 6 12		90 00 00 .0
	12 53 43	Pol. dist.	66 49 55 .2
Ref. table 20	− 4 10		
	12 49 33		
Par. table 16	+ 09	H. D. dec. N. A.	9″.36
True alt.	12 49 42		× $1^h.3$
			2808
			936
		Cor. 12″.2	=12.168

Equa. of time N. A.	$3^m\ 25^s.39$
Cor.	− .64
Cor. equa. of time	3 24 .75

H. D. equa. of time N. A.	$0^s.493$
	$1^h.3$
	1479
	493
Cor. $0^s.64$	=.6409

Obs. alt. L. L.	43° 10′ 20″
Semi-diam. N. A.	+ 15 45
	43 26 05
Dip, table 14	− 6 12
	43 19 53
Ref. table 20	− 1 02
	43 18 51
Par. table 16	+ 07
True alt.	43 18 58

Dec. N. A.	23° 09′ 52″.6 N.
Cor.	− 11 .2
Cor. dec.	23 09 41 .4
	90 00 00 .0
Pol. dist.	66 50 18 .6

H. D. dec.	9″.36
G. M. T.	× $1^h.2$
	1872
	936
Cor. 11″.2	=11″.232

Equa. of time N. A.	$3^m\ 25^s.39$
Cor.	+ .59
Cor. equa. of time	3 25 .98

H. D. equa. of time N. A.	$0^s.493$
G. M. T.	× $1^h.2$
	986
	493
Cor. $0^s.59$	=.5916

First Altitude

A.

Alt.	12° 49′ 42″			
Lat.	35 15 00	Log	sec.	.08797
P. D.	66 49 55	"	cosec.	.03652
	2)114 54 37			
½ sum	57 27 18	"	cos.	9.73075
Alt.	−12 49 42			
Rem.	44 37 36	"	sin.	9.84664
				2)19.70188
	$5^h\ 58^m\ 24^s$ = Sin.			9.85094

Tab. cor. +	04			
L. A. T.	5 58 28 A. M.			
E. of T. +	3 25		4^h =	60°
L. M. T.	6 01 53 A. M.		37^m =	9 15′
G. M. T.	10 39 12 A. M.		19^s =	4 45″
Long.	4 37 19		Long.	69 19 45 W

B.

Alt.	12° 49′ 42″			
Lat.	34 45 00	Log.	sec.	.08531
P. D.	66 49 55	"	cosec.	.03652
	2)114 24 37			
½ sum	57 12 18	"	cos.	9.73371
Alt.	− 12 49 42			
Rem.	44 22 36	"	sin.	9.84471
				2)19.70025
L. A. T.	$5^h\ 59^m\ 20^s$ A. M. = Sin.			9.85012
E. of T. +	3 25		4^h =	60°
L. M. T.	6 02 45 A. M.		36^m =	9 00′
G. M. T.	10 39 12 A. M.		27^s =	6 45″
Long.	4 36 27		Long.	69 06 45 W

Second Altitude.

C.

Alt.	43° 18′ 58″		
Lat.	35 15 00	Log. sec.	.08797
P. D.	66 50 19	" cosec.	.03649
	2)145 24 17		
½ sum	72 42 08	" cos.	9.47325
Alt.	− 43 18 58		
Rem.	29 23 10	" sin.	9.69081
			2)19.28852
	8ʰ 30ᵐ 48ˢ = Sin.		9.64426

Tab. cor.	− 03			
L. A. T.	8 30 45	A. M.		
E. of T.	+ 3 26		4ʰ =	60°
L. M. T.	8 34 11	A. M.	35ᵐ =	8 45′
G. M. T.	1 10 04	P. M.	53ˢ =	13 15″
Long.	4 35 53		Long.	68 58 15 W.

D.

Alt.	43° 18′ 58″		
Lat.	34 45 00	Log. sec.	.08531
P. D.	66 50 19	" cosec.	.03649
	2)144 54 17		
½ sum	72 27 08	" cos.	9.47929
Alt.	− 43 18 58		
Rem.	29 08 10	" sin.	9.68743
			2)19.28852
	8ʰ 30ᵐ 48ˢ = Sin.		9.64426

Tab. cor.	− 03			
L. A. T.	8 30 45	A. M.		
E. of T.	+ 3 26		4ʰ =	60°
L. M. T.	8 34 11	A. M.	35ᵐ =	8 45′
G. M. T.	1 10 04	P. M.	53ˢ =	13 15″
Long.	4 35 53		Long.	68 58 15 W

Taking the first line of position west, a distance of 12 miles, it crosses the second line of position in latitude 34° 58′ 30″ N., and longitude 69° 12′ 45″ W., which is the position of the ship at that time. The first line of position is N. 19° W., and S. 19° E. The sun's true azimuth is at right angle to that line or 90° different, which is N. 71° E.

Taking the second line of position east, a distance of 12 miles, it crosses the first line of position in latitude 34° 58′ 30″ N., and longitude 68° 58′ 15″ W., which is the position of the ship at that time. The second line of position is N. and S. The sun's azimuth is at right angle to that line or 90° different, which is N. 90° E.

16. EXAMPLE: Find the course and distance from a point in latitude 38° 10′ N., and longitude 72° 20′ W. to Sandy Hook Lightship in latitude 40° 28′ 15″ N., and longitude 73° 50′ 09″ W.

Lat. ship	38° 10′ 00″ N.	M. P. table 3	2466′.8
" S. H. L. S.	40 28 15 N.	M. P. " 3	2644.5
Diff. lat.	2 18 15 N.	Mer. diff. lat.	177.7 N.

Long. ship	72° 20′ 00″ W.
" S. H. L. S.	73 50 09 W.
Diff. long.	1 30 09 W.

Mer. diff. lat. 177′.7 N.
Diff. long. 1° 30′ 09 = 90.1 W. } = Course N. 27° W.

Proper diff. lat. 2° 18′ 15″ = 138′.2 = dist. 155 miles.

41, 21. EXAMPLE: December 8, 1902. The observed amplitude of the sun's centre at rising was E. 23° 00′ S. Local apparent time 6^h 37^m A. M. Latitude by account 21° 31′ N., and longitude by account 69° 50′ W. Ship's head N. N. W. Variation 1° W. Find the deviation of the compass.

L. A. T.	6^h 37^m 00^s A. M.	Dec. N. A.	22° 39′ 25″.9 S
Long. 69° 50′ W. =	+4 39 20	Cor. —	11.5
G. A. T.	11 16 20 A. M.	Cor. dec.	22 39 14.4
	12 00 00		
Time from G. A. noon	43 40	H. D. dec. N. A.	16″.49
			× 0^h.7
		Cor. 11″.5	**= 11″.543**

Lat.	21° 31′ N.	Log. sec.	.03137	table 44
Dec.	22 39 S.	" sin.	9.58557	
True amp. E. 24° 27′ S. = Sin.			9.61694	" 44
Com. "	E. 23 18 S.			

Com. error	1 09 E.	Obs. amp. E.	23° 00′ S.
Var. (chart)	+1 00 W.	Cor. table 40	+ 18
Deviation	2 09 E.	Com. amp. E.	23 18 S.

41, 21. EXAMPLE: March 26. 1902. The observed amplitude of the sun's center at setting was W. 5° 30′ S. Local apparent time $5^h\ 56^m$ P. M. Latitude by account 14° 52′ N., and longitude by account 76° 30′ W. Variation 3° E. Find the deviation of the compass.

L. A. T.	$5^h\ 56^m$ P. M.	Dec. N. A.	1° 57′ 00″.0 N.
Long. 76° 30′ W. =	+5 06	Cor.	+ 10 47 .6
G. A. T.	11 02 P. M.	Cor. dec.	2 07 47 .6
		H. D. dec. N. A.	58″.87
		G. A. T.	× 11^h
			5887
			5887
		Cor. 10′ 47″.6	=647″.57

Lat.	14° 52′ N.	Log. sec.	.01479	table 44.
Dec.	2 08 N.	" sin.	8.57084	
True amp. W. 2° 12′ N. = Sin.			8.58563	" 44.
Com. "	W. 5 42 S.			

Com. error	7 54 E.	Obs. amp.	W. 5° 30′ S.
Var. (chart)	−3 00 E.	Cor. table 40	+ 12
Deviation	4 54 E.	Com. amp.	W. 5 42 S.

67, 35. EXAMPLE: Find the length of a knot for a 14^s, 28^s and 30^s glass.

For 14ˢ glass.

Log.	6080 ft.	3.78390
"	14ˢ	+1.14613
		4.93003
"	3600ˢ	−3.55630
"	length of knot 23.64 ft.	=1.37373

For 28ˢ glass.

Log.	6080 ft.	3.78390
"	28ˢ	+1.44716
		5.23106
"	3600ˢ	−3.55630
"	length of knot 47.29 ft.	=1.67476

For 30ˢ glass.

Log.	6080 ft.	3.78390
"	30ˢ	+1.47712
		5.26102
"	3600ˢ	−3.55630
"	length of knot 50.66 ft.	=1.70472

All these logarithms are from table 42.

EXAMPLE: January 20, 1902. The observed altitude of the sun's lower limb was 12° 15′. Local apparent time 3^h 59^m P. M. Latitude by account 31° 36′ N., and longitude by account 77° 20′ W. The sun's azimuth by compass N. 122° 00′ W. Ship's head N. 32° E. Height of eye 40 feet. Variation 1° W. Index correction −3′ 40″. Find the deviation of the compass.

L. A. T.	3^h 59^m 00^s P.M.	Dec. N. A.	20° 15′ 28″.5 S.
Long. 77° 20′ W. = +	5 09 20	Cor.	− 4 50 .4
G. A. T.	9 08 20 P.M.	Cor. dec.	20 10 38 .1
			90 00 00 .0
		Pol. dist.	110 10 38 .1

Obs. alt. L. L.	12° 15′ 00″	H. D. dec. N	31″.91
I. C.	− 3 40	G. M. T.	× 9ʰ.1
	12 11 20		3191
Semi-diam. N. A.	+ 16 16		28719
	12 27 36	Cor. 4′50″.4	= 290″.381
Dip, table 14	− 6 12		
	12 21 24		
Ref. table 20	− 4 20		
	12 17 04		
Par. table 16	+ 09		
True alt.	12 17 13		

P. D.	110° 10′ 38″			
Lat.	31 36 00	Log. secant	.06970	table 44
Alt.	12 17 13	" secant	.01006	table 44
	2)154 03 51			
½ sum	77 01 55	" cosine	9.35099	table 44
P. D.	110 10 38			
Diff.	33 08 43	" cosine	9.92285	table 44
			2)19.35360	
½ true az.	61° 38′	= Cosine	9.67680	table 44
	× 2			
True az.	N. 123 16 W.			
Com. "	N. 122 00 W.			
Com. error	1 16 W.			
Var. (chart)—	1 00 W.			
Dev.	16 W.			

EXAMPLE: August 10, 1902. The observed altitude of the sun's lower limb was 43° 50′ 30″. Local apparent time 8ʰ 45ᵐ 00ˢ A. M. Latitude by account 23° 45′ N., and longitude by account 83° 30′ W. The sun's azimuth by compass was N. 94° 30′ E. Ship's head S. 64° W. Height of eye 35 feet. Variation 3° E. Find the deviation of the compass and the true course.

L. A. T.	$8^h 45^m$ A. M.	Dec. N. A.	15° 46′ 32″.1 N.
Long. 83° 30′ W. =	+5 34	Cor.	− 1 39 .9
	14 19	Cor. dec.	15 44 52 .2
	−12 00		90 00 00 .0
G. A. T.	2 19 P. M.	Pol. dist.	74 15 07 .8

Obs. alt. L. L.	43° 50′ 30″	H. D. dec. N. A.	43″.44
Semi-diam. N. A.	+ 15 48	G. A. T. $2^h 19^m$ =	× 2^h.3
	44 06 18		13032
Dip, table 14	− 5 48		8688
	44 00 30	Cor. 1′ 39″.9	=99.912
Ref. table 20	− 1 00		
	43 59 30		
Par.	+ 07		
True alt.	43 59 37		

P. D.	74° 15′ 08″			
Lat.	23 45 00	Log. secant	.03843	table 44
Alt.	43 59 37	" secant	.14307	table 44
	2)141 59 45			
½ sum	70 59 52	" cosine	9.51264	table 44
P. D.	74 15 08			
Diff.	3 15 16	" cosine	9.99930	table 44
			2)19.69344	
½ true az.	45° 22′	= Cosine	9.84672	table 44
	× 2			

True az.	N. 90 44 E.	Com. course	S. 64° 00′ W.
Com. "	N. 94 30 E.	" error	−3 46 W.
Com. error	3 46 W.	True course	S. 60 14 W.
Var. (chart)	+3 00 E.		
Dev.	6 46 W.		

Example: October 27, 1902, A. M. The observed altitude of the star Regulus was 27° 53′ 40″ E. Time by chronometer was $7^h\ 52^m\ 10^s$ A. M., and fast $2^m\ 04^s$. Latitude by account 26° 12′ N. Index correction −2′ 30″. Height of eye 30 feet. Find the longitude.

Obs. alt.	27° 53′ 40″	Chro.	$7^h\ 52^m\ 10^s$ A. M.	Civil T.
I. C.	− 2 30	Fast.	− 2 04	Oct. 27
	27 51 10	G. M. T.	7 50 06 A. M.	
Dip, table 14	− 5 22		+12 00 00	
	27 45 48	G. M. T.	19 50 06	Ast. time Oct. 26
Ref. table 20	− 1 50			
True alt.	27 43 58			

Sid. time N. A. Oct. 26	$14^h\ 15^m\ 42^s$	Dec. N. A.	12° 26′ 47″
Cor. for $19^h\ 50^m$ tab. 9 +	3 15	Cor. for 10 months −	15
Cor. sid. time	14 18 57	Cor. dec.	12 26 32
			90 00 00
		Pol. dist.	77 33 28

Alt.	27° 43′ 58″				
Lat.	26 12 00	Log. secant	.04708	table 44
P. D.	77 33 28	" cosecant	.01032	
	2)131 29 26			
½ sum	65 44 43	" cosine	9.61362	
Alt.	−27 43 58			
Rem.	38 00 45	" sine	9.78946	
			2)19.46048	
	$4^h\ 20^m\ 00^s$ = Sine		9.73024	table 44

Tab. cor.	+ 01		
Star's H. A.	4 20 01 E.		
" R. A., N. A.	10 03 09	4^h =	60°
R. A. M.	+ 24^h 5 43 08	25^m =	6 15′
Cor. sid. T.	−14 18 57	55^s =	13 45″
L. M. T. (ast.)	15 24 11	Long.	66 28 45 W
G. M. T. (ast.)	19 50 06		
Long.	4 25 55		

Example: March 30, 1902, P. M. The observed altitude of the star Rigel was 28° 15′ 50″ W. Time by chronometer was $13^h\ 06^m\ 50^s$, and slow $2^m\ 10^s$. Latitude by account 17° 10′ N. Index correction +3′ 00″. Height of eye 40 feet. Find the longitude.

Obs. alt.	28° 15′ 50″	Chro.	$13^h\ 06^m\ 50^s$ Ast. time
I. C.	+ 3 00	Slow	+ 2 10
	28 18 50	G. M. T.	13 09 00 " "
Dip, table 14	− 6 12		
	28 12 38		
Ref. table 20	− 1 49		
True alt.	28 10 49		

Sid. time N. A.	$0^h\ 27^m\ 45^s$	Dec. N. A.	8° 18′ 53″ S.
Cor. for $13^h\ 09^m$ table 9	+ 2 10		+90 00 00
Cor. sid. time	0 29 55	Pol. dist.	98 18 53

Alt.	28° 10′ 49″			
Lat.	17 10 00	Log. secant	.01979	table 44
P. D.	98 18 53	" cosecant	.00459	table 44
	2)143 39 42			
½ sum	71 49 51	" cosine	9.49392	table 44
	28 10 49			
Rem.	43 39 02	" sine	9.83901	table 44
			2)19.35731	

Star's H. A.	$3^h\ 48^m\ 00^s$ W. = sine 9.67865 table 44		
" R. A., N. A.	5 09 50		
R. A. M.	8 57 50		
Cor. sid. T.	− 29 55	4^h	= 60°.
L. M. T. (ast.)	8 27 55	41^m	= 10 15′
G. M. T. (ast.)	13 09 00	5^s	= 1 15″
Long.	4 41 05 W.	Long.	70 16 15 W

Example: April 1, 1902, P.M. The observed meridian altitude of the star Procyon was 49° 58′ 15″ S. Index correction — 2′ 30″. Height of eye 40 feet. Find the latitude.

Star's R. A., N. A.		7^h	34^m	10^s	
Sun's R. A., N. A.	—		39	49	
L. A. T. star's mer. pass.		6	54	21	P. M.

Obs. alt.		49°	58′	15″	S.
I. C.	—		2	30	
		49	55	45	
Dip, table 14	—		6	12	
		49	49	33	
Ref. table 20	—			49	
True alt.		49	48	44	
		90	00	00	
Zen. dist.		40	11	16	N.
Dec. N. A.		5	28	34	N.
Lat.		45	39	50	N.

EXAMPLE: February 15, 1902, P.M. The observed meridian altitude of the star Sirius was 34° 40′ 30″ S. Index correction + 2′ 20″. Height of eye 35 feet. Find the latitude.

Star's R. A., N. A.		6h	40m	50s
	+	24	00	00
		30	40	50
Sun's R. A., N. A.	−	21	52	38
L. A. T. star's mer. pass.		8	48	12 P. M.

Obs. alt.		34°	40′	30″ S.
I. C.	+		2	20
		34	42	50
Dip. table 14	−		5	48
		34	37	02
Ref. table 20	−		1	24
True alt.		34	35	38
		90	00	00
Zen. dist.		55	24	22 N.
Dec. N. A.	−	16	34	54 S.
Lat.		38	49	28 N.

RULES
INSTRUCTIONS
AND
OTHER USEFUL INFORMATION
FOR
APPLICANTS FOR LICENSE

How to Obtain a License.

First, go to the United States Local Inspectors of steam vessels, obtain a blank application and an order to the Marine Hospital Surgeon, who will examine the eyes. Then fill in the application with the experience, stating the name and gross tonnage of each vessel, the capacity served in and period of service.

The application must be signed by persons holding a certificate of a grade not lower than that for which the application calls. Or it may be signed by owners or agents of vessels in which the applicant has served. The signers must be of good reputation and have a personal knowledge of the correctness of the statements set forth in the application. Three signers are required.

The statements set forth in the application must be supported by letters or discharges from the masters, owners or agents of the vessels in which the applicant has served.

Notice.

An Act To amend section forty-four hundred and forty-five, of title fifty-two, of the Revised Statutes of the United States relating to the licensing of officers of steam vessels.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section forty-four hundred and forty-five, of title fifty-two, of the Revised Statutes, be, and is hereby, amended by adding thereto the following paragraphs:

"Every applicant for license as either master, mate, pilot, or engineer under the provisions of this title shall

make and subscribe to an oath or affirmation, before one of the inspectors referred to in this title, to the truth of all the statements set forth in his application for such license.

"Any person who shall make or subscribe to any oath or affirmation authorized in this title and knowing the same to be false shall be deemed guilty of perjury.

"Every licensed master, mate, pilot, or engineer who shall change, by addition, interpolation, or erasure of any kind, any certificate or license issued by any inspector or inspectors referred to in this title shall, for every such offense, upon conviction, be punished by a fine of not more than five hundred dollars or by imprisonment at hard labor for a term not exceeding three years."

SEC. 2. That this Act shall take effect immediately.

Approved, March 23, 1900.

Articles Required.

When an applicant presents himself for examination, it is important that he have the following articles with him:

One rubber eraser, one end for pencil and the other for ink.

One sharp pocket knife to be used as an eraser and for sharpening lead pencils.

One set of azimuth tables, from 60° south to 60° north, to be used in finding the true azimuth and amplitude.

Any epitome of navigation that the applicant may wish.

One small ruler for constructing traverse tables, etc.

One of Cap. Pugsley's Course Correctors.

Three or four lead pencils, and pens.

Letters of Service.

The law requires that the U. S. Local Inspectors shall have proper written evidence supporting the statements set forth in an application for a license.

Most letters of recommendation are given with good intention and a desire that they may be of value to the person to whom they are given. Strange as it may seem, many letters which are very strong recommendations, prove to be absolutely worthless when put before the U. S. Local Inspectors as evidence to support some statement made in an application.

As such letters so frequently inconvenience the applicant and annoy the U. S. Local Inspectors, the following form is suggested.

A Proper Letter.

New York, Jan. 7, 1904.

To whom it may concern:—

This is to certify that Mr. John Jones has been mate in the bark Pole Star from July 6, 1903, to the above date and during that time he proved to be a sober, honest, capable and reliable officer, and I recommend him as such.

JOHN BROWN,
Master bark Pole Star.

A Worthless Letter.

New York, Jan. 7, 1904.

To whom it may concern:—

This is to certify that Mr. John Jones has been mate with me for six months and I have always found him to be sober, honest and reliable in all his dealings.

JOHN BROWN,
Master bark Pole Star.

The above style of letter reads very well, but is worthless when presented to the U. S. Local Inspectors because the time of service, name of the ship and qualifications as a seaman are not mentioned.

The service given in the application for license as master of ocean going steamers, entitles the applicant to the license as master of both steam and sailing ships.

The service given in the application for license as master of sail vessels entitle the applicant to license as chief mate of steam ships.

The figures in brackets after the name of each vessel indicates her gross tonnage.

Form 2124.

APPLICATION FOR LICENSE AS MASTER (Lakes and Seaboard.)

New York, N. Y.

Dec. 9th, 1902.

To the U. S. Inspectors of Steamboats:

I, John Martin, [if native], being over 21 years of age, having been born at Boston, State of Mass., in the year 1874, ________ [if foreign born], born at ________ in ________, in the year 18 ; was naturalized in the ________ Court of ________, in the State of ________, on the ________ day of ________, 1 , and am now a resident of New York, in the State of New York.

I HEREBY respectfully apply for *LICENSE* as Master of ocean-going steamers for the waters of any ocean, and submit the following statement of my experience, and testimonials of character and qualifications: Ship Jacob (1450) mate, Jan. 6/96 to Mar. 9/97. Bark Ajax (940) mate, March 24/97 to Dec. 8/97 and master, Dec. 9/97 to May 16/99. Schr. Daylight (340) master, May 20/99 to June 12/1901. Schr. Isabella (320) master June 30/1901 to July 17/1902. Brig Minerva (316) master, July 20/1902 to the above date.

And I further say that I have not made application to the Inspectors of any other District and been rejected within twelve months of the date of this application.

Sworn to before me this ________ * John Martin,

day of ________, 190 . 154 Broad St. (*City or Town.*)

State of New York City.

________, *Inspector.*

WE, THE UNDERSIGNED, DO CERTIFY, from personal knowledge of the above named John Martin, that he is a person of temperate habits and of good character, and recommend him as a suitable person to be entrusted with the duties of the station, as above, for which he makes application.

John Thomas, owner Schr. Daylight.

David Jones, master s/s Juno.

Wm. Brown & Son, Ship Brokers.

NOTICE.—Applicants for license will pay particular attention to the following requirements when filling up this application.

First.—State character and grade of license asked for.

Second.—Date of application.

Third.—Character and grade of license (if pilot, state route).

Fourth.—In stating experience, give names of vessels, length of time, and in what capacity employed.

Fifth.—Sign application with full name.

Sixth.—To be signed only by persons having full personal knowledge of the facts set forth.

☞ Local Inspectors must insist that all the required details in regard to nativity and citizenship are filled out before acting on this application.

* The attention of applicant is called to the Act of Congress approved on March 23, 1900, making it perjury to swear falsely to any statement set forth by him in this application, punishable by fine or imprisonment.

2—749

Form 2124 C.
STEAMBOAT INSPECTION SERVICE.

Application for License as Master or Chief Mate of Sail Vessels of over 700 Gross Tons.

New York,
Dec. 9th, 1902.

To the U. S. Local Inspectors of Steam Vessels,
Port: New York.

GENTLEMEN : I, James Brown, hereby respectfully apply for LICENSE as Master of Sail Vessels of over 700 gross tons.

I am a Native (Native or naturalized.) citizen of the United States, over 21 years of age, having been born in the year 1874, at New York, in New York (State or Country.) (if foreign born), was naturalized in the ______ Court at ______, in the State of ______, on the ______, 1 , am now a resident of New York, in the State of New York; and submit the following statement of my experience and testimonials of character and qualifications: Bark Thomas (840) mate, June 1/96 to May 4/97. Brig Eva (384) mate, May 20 97 to Dec. 16 97. Schr. North Wind (318) mate, Dec. 19 97 to Nov. 8/98. Schr. Pole Star (335) mate, Nov. 20 98 to July 17/99. Schr. David Jones (315) mate, Aug. 2 99 to Jan. 14/1902. Schr. Red Wing (368) mate, Jan. 26/1902 to Dec. 5/1902.

And I further say that I have not made application to the Inspector of any other District and been rejected within twelve months of the date of this application.

Sworn to before me this ______
day of ______, 1

James Brown,
987 Fulton St. *(City or Town.)*
State of New York City.

______, *Inspector.*

WE, THE UNDERSIGNED, DO CERTIFY, from personal knowledge of the above-named James Brown, that he is a person of temperate habits and of good character, and recommend him as a suitable person to be entrusted with the duties of the station, as above, for which he makes application.

John Miller, Agt. Brig Eva.
George Jones, Master Schr. Etta.
Sam. Samson's Sons, Agts. Schr. Red Wing.

NOTICE.—Applicants for license will pay particular attention to the following requirements when filling up this application:
First.—State place and date of application.
Second.—State class of license.
Third.—In stating experience, give names of vessels, length of time, and in what capacity employed.
Fourth.—Sign application with full name.
Fifth.—**To be signed only by persons having full personal knowledge of the facts set forth.**
Local Inspectors must insist that all the required details in regard to nativity and citizenship are filled out before acting on this application.
2—4033.

3, 3. Latitude by Meridian Altitude of the Sun.

An altitude of the sun is observed when on the meridian and to it apply the instrumental error or index correction according to the sign — or +. Take from page I of the Nautical Almanac, the semi-diameter for the day and add it to the altitude if the lower limb was observed; but subtract it if the upper limb. From Table 14 take the dip corresponding to the height of the eye above the level of the sea and subtract it from the altitude. Corresponding to this altitude, the refraction will be found in Table 20 and must be subtracted from the altitude. With this altitude, enter Table 16 and take out the parallax which is additive to the altitude. The result of applying these corrections will be the true altitude of the sun's centre.

Subtract the true altitude of the sun's centre from 90° and the result will be the zenith distance, and is named contrary to the sun's bearing at the time of observation. That is, if the sun bore south when observed, the zenith distance would be north. On the other hand, if the sun bore north the zenith distance would be south.

Turn the longitude by account into time by Table 7. The minutes of time are reduced to a decimal by dividing them by six, because six is a tenth of sixty, there being sixty minutes in an hour.

From page I of the Nautical Almanac, take the sun's declination and multiply the hourly difference by the longitude in time, and apply the product to the declination by the following rule:

In west longitude, declination increasing, add; decreas-

ing, subtract. In east longitude, declination increasing, subtract; decreasing, add.

The result will be the correct declination and the latitude is found and named as follows:

If the zenith distance and declination are of same name, add them together, and the result will be the latitude. If zenith distance and declination are of different name, subtract the lesser from the greater and the remainder will be the latitude, which takes the name of the greater.

The method known as 89° 48′ will not be accepted by the examiner, and no attempt should be made to use it, as by it the correct result cannot be obtained except approximately so, under certain conditions—that is, when the zenith distance is small and the dip from twelve to fifteen feet. When the altitude is low and the dip from thirty to forty feet or more, the error of the method will be several miles.

By using the 89° 48′ method in working the second example on page 25, a difference of about four miles will be found.

4. Latitude by Ex-Meridian Altitude of the Sun.

An altitude of the sun is observed as near noon as possible and the time noted by chronometer. Correct the altitude and turn the longitude by account into time as explained in LATITUDE by MERIDIAN ALTITUDE of the SUN, on page 65, and to the time noted by the chronometer, apply the rate, and the result will be the Greenwich Mean Time.

From page II of the Nautical Almanac, take the sun's declination and hourly difference. If the Greenwich mean time is P. M., multiply the hourly difference by it, and the product will be the correction to be added to the declination if increasing; and subtracted if decreasing.

If the Greenwich mean time is A. M., it must be subtracted from twelve hours, which will give the time from Greenwich noon, and with it multiply the hourly difference, and the product will be the correction to be subtracted from the declination, if increasing, and added if decreasing; and the result will be the correct declination.

Correct the equation of time by the same method used in correcting the declination.

Apply the corrected equation of time to the Greenwich mean time as directed on page II of the Nautical Almanac, and the result will be the Greenwich apparent time. To this time add the longitude by account in time if east. If the longitude is west, subtract it from the Greenwich apparent time, and the result will be the local apparent time. If the local apparent time is more than twelve hours, subtract twelve hours from it. If less than twelve

hours, subtract it from twelve hours, and the result will be the hour angle.

The remainder of this calculation may be performed as explained on page 9, or the more simple and convenient method by which Tables 26 and 27 are used, may be taken. It is as follows:

Having the true altitude, corrected declination and hour angle, the reduction is required.

The first part of Table 26 is to be used when the latitude by account and declination are of different names. The second part is to be used when these two elements are of same name.

Enter Table 26 with the declination at the top of the page and the latitude at the side. Take out the number found under the declination and opposite the latitude by account. Multiply this number by the number from Table 27 corresponding to the hour angle. The result will be the reduction in seconds (″) which is added to the true altitude, and the result will be the meridian altitude. Find the latitude now the same as explained in LATITUDE by MERIDIAN ALTITUDE of the SUN, on page 65.

In practice, if the latitude found does not agree with the latitude by account, another latitude is assumed nearer that found by calculation. The work may thus be repeated until the latitude by account and that by calculation agree nearly, and may then be relied on as very nearly the correct latitude.

5. Latitude by Meridian Altitude of the Moon.

Before attempting to perform this calculation, or finding the latitude by an altitude of the Pole Star, it is absolutely necessary that the applicant should have a thorough understanding of the meaning of astronomical time.

Astronomical time is nothing more or less than the number of hours, etc., past the last noon. If the civil time is A. M., the astronomical date will be one day less than the civil date.

If the civil time is P. M., the astronomical and civil dates are the same.

To turn civil time into astronomical time the rule is as follows:

If the civil time is A. M., add twelve hours to it and put the date back one day.

If the civil time is P. M., it is the astronomical time and date as it stands.

The Observation.

From page IV of the Nautical Almanac, take the time of the moon's meridian passage at Greenwich for the civil date if the Greenwich time is P. M. If the Greenwich time is A. M., take it out for the preceding date. Multiply the hourly difference by the longitude in time, and in west longitude add the product, and in east longitude subtract it from the time of the meridian passage at Greenwich, and the result will be the local mean time of the meridian passage in the longitude used. The Green-

wich mean time of the passage in that longitude is found by adding the longitude in time, if west, and subtracting it if east, from the local mean time of the moon's meridian passage. This Greenwich mean time is used for correcting the declination, and also as a guide to which columns to take the semi-diameter and horizontal parallax from.

The altitude is observed when the body is on the meridian, and to it the instrumental error, semi-diameter and dip are applied. The result will be the apparent altitude. The semi-diameter and horizontal parallax are found on page IV of the Nautical Almanac, and must be taken from the column the Greenwich time of observation is nearest to—noon or midnight.

Enter Table 24 with the horizontal parallax at the top of the page and the apparent altitude at the side. Under the parallax and opposite the altitude will be found a correction for the parallax in altitude, including the refraction and is always added to the apparent altitude. The result will be the true altitude, which is subtracted from ninety degrees to obtain the zenith distance.

From the Nautical Almanac, take the declination out for the Greenwich astronomical date and hour. Multiply the minute difference by the odd minutes of time, and the product will be the correction for the declination. If the declination is increasing add it, and if decreasing subtract it from the declination.

If the zenith distance and declination are of same name, add them together and the result will be the latitude.

If the zenith distance and declination are of different name, subtract the lesser from the greater, and the re-

ınainder will be the latitude, and takes the name of the greater.

There are small corrections for the semi-diameter and parallax; but as their value is very small, unimportant and the examiner not requiring that they be used, they ar(not considered in this work.

6, 4. Latitude by Altitude of the Polar Star.

The altitude may be observed at any time and must be corrected for instrumental error, dip and refraction. Semi-diameter and parallax are not applied to the altitude of any star because they are too small for consideration.

To the local mean time expressed astronomically, add the longitude by account in time if west; but subtract it if east, and the result will be the Greenwich astronomical mean time.

Take the sidereal time from page II of the Nautical Almanac for the astronomical date.

Add together the local mean time, sidereal time from page II of the Nautical Almanac, and the correction from Table 9 corresponding to the Greenwich astronomical mean time. The sum will be the local sidereal time, and if it exceeds twenty-four hours, subtract twenty-four hours from it.

Take from page 248 of the Nautical Almanac the star's right ascension, and subtract it from the local sidereal time, and the remainder will be the star's hour angle. Turn this hour angle into degrees, the same as time is turned into longitude.

Take from page 248 of the Nautical Almanac the star's declination and subtract it from ninety degrees and turn the remainder into miles. This result is called the star's polar distance in miles.

With the star's hour angle turned into degrees, enter Table 44 and take out the corresponding logarithm cosine.

With the star's polar distance in miles, enter Table 42 and take out its logarithm.

Add these two logarithms together, and with the resulting logarithm enter Table 42 and take out the corresponding number, which will be the correction in miles, to be applied to the star's true altitude according to the following rule, and the result will be the latitude, which is always north.

When the hour angle is less than six hours or more than eighteen hours, subtract the correction from the true altitude.

When the hour angle is more than six hours and less than eighteen hours, the correction is to be added to the true altitude.

If local apparent time is given in the example, use the sun's right ascension from page I of the Nautical Almanac instead of the sidereal time from page II.

As this is a correct method of performing this calculation, the examiner will prefer it, but will accept the method given in the Nautical Almanac, page 272, which is very nearly correct and sufficiently so for all practical purposes.

The applicant will probably be given an example containing the longitude, local time and Greenwich time. In that case no notice should be given the longitude, as it is of no use.

If the Greenwich time and longitude are given, use them to find the local time.

If the local time and longitude are given, use them to find the Greenwich time.

Sometimes the examiner will ask why the latitude by this observation is north. The correct answer to the

question is that the observation can be obtained in north latitude only, as the Pole Star is not visible south of the equator, except a few miles at certain times, but not of sufficient altitude for the purposes of observation.

8, 6. Day's Work and Middle Latitude Sailing.

After constructing the traverse table, reverse the bearing of the light or other prominent object and enter it with the distance off, variation, etc., in the traverse table as the first course. If a deviation table is given, take the deviation out for the ship's head at the time the bearing was taken, and not for the bearing.

Enter the other courses in the traverse table in the order given. In correcting them for leeway, be careful not to make the mistake of applying leeway to the bearing or the current course.

In correcting the courses for leeway, apply it to the right when on the port tack and to the left on the starboard tack. Correct the courses for deviation and variation by applying the westerly to the left and the easterly to the right.

The direction of the current must be entered as if a course really sailed, and the distance will be the rate per hour multiplied by the number of hours in it, usually twenty-four hours. If the direction of the set of the current is magnetic, the variation must be applied; but if given as true, do not apply any correction to it. Do not apply deviation or leeway to the current course in any case.

Having corrected the courses, take the difference of latitude and departure from Table 2 for each course and distance, and place them in their respective columns in the traverse table.

In taking the difference of latitude and departure from Table 2, read from the top of the page when the course is less than forty-five degrees and from the bottom when

greater. When the course is forty-five degrees, it will be noticed that the top and bottom of the page are the same.

Having taken from Table 2 the differences of latitude and departures for each course, add up each column separately. Find the difference between the two latitude columns, and call it the difference of latitude and name it the same as the greater of the two columns, which will be either north or south.

Find the difference between the two departure columns, and call it the departure and name it the same as the greater of the two columns, which will be either east or west.

If the difference of latitude and the latitude left are of the same name, add them together, and the result will be the latitude in, which takes the same name.

If the difference of latitude and latitude left are of different name, subtract the lesser from the greater, and the remainder, taking the name of the greater, will be the latitude in. If the difference of latitude is greater than the latitude left and of a different name, the ship has crossed the equator, and the latitude in will be the same name as the difference of latitude.

Add together the latitude left and the latitude in, if of same name, and divide their sum by two, and the result will be the middle latitude.

If the latitude in and the latitude left are of different name, divide their difference by two, and the result will be the middle latitude.

Turn to Table 2 with this middle latitude as if a course, and find the departure in the latitude column, and

the corresponding number in the distance column will be the difference of longitude. Take care to read from the same end of the page as the middle latitude is found. The difference of longitude is given the same name as the departure—east or west.

If the difference of longitude and longitude left are of the same name, add them together, and the result will be the longitude in, which takes the same name. If the longitude in is greater than 180°, subtract it from 360° and change its name, as the ship has crossed the 180th meridian. To find the course and distance, enter Table 2 with the difference of latitude and departure. If the difference of latitude is the greater, read from the top of the page. If the departure is the greater, read from the bottom of the page.

Where the difference of latitude and departure are found to agree, the corresponding number in the distance column will be the distance. The course is taken from the top of the page if the difference of latitude is the greater; but from the bottom if the departure is the greater. The course is given the same names as the difference of latitude and departure.

The DAY'S WORK problems given by the examiner always require the course and distance from the ship's position to some light or other prominent point by either middle latitude or Mercator's sailing. Middle latitude sailing is explained here and Mercator's sailing is explained fully under that head.

Correcting the courses may be simplified by using Capt. R. M. Pugsley's "Course Corrector." Price 50 cents.

9, 7. Longitude by Chronometer.

The old idea of taking the mean of three altitudes has long ago been proven to be incorrect and is not practised by the more eminent navigators of the present day. However, the method is curiously advocated by many writers, who seem loth to throw aside the traditions of the past for the needs of the modern navigator. No other reason can be advanced except probably a lack of practical knowledge of the subject.

It is quite correct to observe three altitudes and it is a very simple matter to find the longitude from the second altitude, and if the result is the same as that found by the first altitude, the longitude may be relied upon.

If the two longitudes found are different more than the ship's change of longitude between the two observations, which would be, say, a quarter (15″) of mile, something is in error. Then find the longitude by the third altitude. This result will in all probability agree with one of the others. The incorrect calculation may be selected at once and its error found. It may be in the altitude, reading the instrument, in noting the time, or in the work. By using the mean of three altitudes in such a case, the longitude found would certainly be in error, and worse still, the error would be hidden.

In the determination of longitude by the use of a chronometer, never lose sight of the fact that the result, supposing the work to be correct, is dependent upon the accuracy of that very important time piece.

The observed altitudes should not be less than twelve

degrees, on account of the uncertainty of the refraction for lower altitudes.

The altitude should be observed when the body is on or near the prime vertical as possible—that is, when it bears as near the true east or west as possible. The reason for this is that an error of a few miles in the latitude by account will not affect the longitude obtained.

The examiners usually give the applicant a complicated problem, such as given on pages 71 and 73 of this work.

Correct the chronometer by applying its error and rate, and the result will be the Greenwich mean time of the observation.

The observed altitude is then corrected by applying the instrumental error, semi-diameter, dip, refraction and parallax, and the result will be the true altitude.

Take from page II of the Nautical Almanac the sun's declination and hourly difference, and the equation of time and its hourly difference.

If the Greenwich mean time is P. M., multiply the hourly difference by it, and the product will be the correction to be added to the declination if increasing; and subtracted if decreasing.

If the Greenwich mean time is A. M., it must be subtracted from twelve hours, which will give the time from Greenwich mean noon, and with it multiply the hourly difference, and the product will be the correction to be subtracted from the declination, if increasing, and added if decreasing; and the result will be the correct declination.

Correct the equation of time by the same method used in correcting the declination.

If the latitude and declination are of the same name, subtract the declination from ninety degrees. If the latitude and declination are of different name, add the declination to ninety degrees, and the result will be the polar distance.

Correct the meridian altitude by applying to it the usual corrections as described in LATITUDE by MERIDIAN ALTITUDE of the SUN, on page 102.

In the example given by the examiner, either the Greenwich mean time or the longitude by account are given with the meridian altitude. If the Greenwich mean time is given, correct the declination by the rule given above. If the longitude by account is given, correct the declination by the following rule:

Take from page I of the Nautical Almanac, the sun's declination and multiply the hourly difference by the longitude by account (which is the time from Greenwich apparent noon), and the product will be the correction to be applied to the declination as follows:

In west longitude, declination increasing, add; decreasing, subtract.

In east longitude, declination increasing, subtract; decreasing, add.

If the examiner should give both the Greenwich time and longitude by account in connection with the meridian altitude, disregard the longitude and use the Greenwich time. If the Greenwich apparent time is given, take the declination from page I of the Nautical Almanac.

The zenith distance is found by subtracting the true meridian altitude from ninety degrees and the latitude found as follows:

If the zenith distance and declination are of same name, add them together, and the result will be the latitude. If zenith distance and declination are of different name, subtract the lesser from the greater and the remainder will be the latitude, which takes the name of the greater.

It must be remembered that the latitude thus determined is for noon and cannot be used, as it stands for finding the longitude.

It is always stated in the problem that the ship sailed a certain course and distance from the time the altitude was observed in the morning to noon, when the meridian altitude was observed. Variation, deviation, and sometimes leeway are given with this course.

Construct a traverse table and in it enter the course and distance and the various corrections. Correct the course and with it enter Table 2, and take out the corresponding difference of latitude and departure and place them in their respective columns.

The difference of latitude thus found when properly applied to the latitude at noon, will give the latitude the ship was in when the altitude in the morning was obtained.

If the ship sailed south in north latitude, add the difference of latitude to the latitude at noon; but if she sailed north, subtract it, and the result will be the latitude in at the time of the morning observation.

If the ship sailed north in south latitude, add the difference of latitude to the latitude at noon; but if she sailed south, subtract it, and the result will be the latitude in at the time of the morning observation. This latitude is

to be used with the morning altitude and polar distance to find the longitude.

Add together the latitude at noon and the latitude in the morning, if they are of same name, and divide their sum by two. The result will be the middle latitude. If the ship is on or very near the equator, the departure and difference of longitude will be equal for such short distance.

Enter Table 2 with this middle latitude as a course and find the departure in the latitude column, and the corresponding number in the distance column will be the difference of longitude to be used in bringing the longitude of the morning when found up to noon.

Having the true altitude, latitude and polar distance, add them together and divide the sum by two, which will give the half sum. From this half sum subtract the true altitude, and the result will be the remainder.

From Table 44 take out the logarithms as follows:

Latitude,	logarithm	secant.
Polar distance,	"	cosecant.
Half sum,	"	cosine.
Remainder,	"	sine.

When the polar distance is greater than eighty-nine degrees, or in other words, when it is found at the lower left-hand corner of the page, do not make the mistake of using the miles in the right-hand column. Use the left-hand column. Always take the miles in every case from the column at which the degrees are placed. To correct the logarithms for seconds ("), see instructions on page 626 of Bowditch Epitome.

Add these four logarithms together and divide their sum by two, and the result will be the logarithm sine of apparent time of the morning observation.

Enter Table 44 with this logarithm sine in the proper column and take out the time corresponding to it. If there is any difference between the two logarithms, a correction will be found at the bottom of the page corresponding to the difference. This difference must be applied to the time taken from the table.

In taking the time from the table, care must be taken to get the time from the proper column—that is, A. M. or P. M., at the same time having regard whether the top or bottom of the page is being used.

To this local apparent time, apply the equation of time as directed in the Nautical Almanac, and the result will be the local mean time.

The difference between the local mean time and the Greenwich mean time will be the longitude in time. Turn this into degrees, etc., and it will be the morning longitude.

To this longitude apply the difference of longitude referred to in the small traverse table, and the result will be the longitude at noon, and is that longitude which is entered in the ship's log book.

From this noon position the applicant is required to find the course and distance by either middle latitude or Mercator's sailing, or both, to some light or other prominent object, and it is not uncommon for the examiner to call for the sun's true azimuth, to be found from the

elements of the chronometer sight, and then determine the compass error and deviation.

The applicant may use the azimuth table, to find the true azimuth; but he must bring the tables with him. No particular tables are required. Any of those published will be allowed.

10. Longitude by Sunset and Sunrise.

In this observation the time is noted by chronometer the instant the upper or lower limb of the sun is in exact contact with the horizon. It is the general custom to observe the contact with a telescope; but it is not absolutely necessary to do so. Probably a better result may be obtained without any aid other than a colored glass to protect the eye. One of the shades on the sextant will answer the purpose very well.

Some writers advocate the use of 21′ for the lower limb observation and 53′ for the upper limb as constant quantities for the negative altitude. However, the method is not correct except under certain conditions, and while some examiners will accept it, others will not.

The only safe plan is to compute the negative altitude.

To compute the negative altitude, take the refraction for altitude 0° from Table 20, and to it add the dip from Table 14, corresponding to the height of the eye above the level of the sea. From this result subtract the sun's semi-diameter from page I of the Nautical Almanac for the day and then subtract the parallax for altitude 0° from Table 16. The result will be the negative altitude for a lower limb observation.

For the upper limb, add together the refraction, dip and semi-diameter and from the sum subtract the parallax.

Having observed the contact and noted the time by chronometer, apply the error and rate to the chronometer time, which will give the Greenwich mean time.

Take from page II of the Nautical Almanac the sun's declination and equation of time.

If the Greenwich time is P. M., multiply the hourly difference by it, and the product will be the correction to be added to the declination if increasing; and subtracted if decreasing.

If the Greenwich time is A. M., it must be subtracted from twelve hours, which will give the time from noon, and with it multiply the hourly difference, and the product will be the correction to be subtracted from the declination if increasing, and added if decreasing. The result will be the corrected declination.

The equation of time is corrected the same way.

If the latitude and declination are of the same name, subtract the declination from ninety degrees.

If the latitude and declination are of different name, add the declination to ninety degrees, and the result will be the polar distance.

Add together the latitude and polar distance and from their sum subtract the negative altitude. Divide this result by two to obtain the half sum and to this add the negative altitude, which will give the remainder.

From this point the work is exactly the same as finding longitude by the usual method.

11. Longitude by Two Altitudes Near Noon.

About as many minutes before noon as the ship is degrees from the equator, the sun's altitude is observed and the time noted by chronometer. If after the first observation the ship sails towards the sun, the reading on the instrument must be increased by as many minutes and seconds as are in the difference of latitude. If the ship sails from the sun, the reading on the instrument must be decreased by that quantity.

When the sun falls to an altitude corresponding to the reading on that instrument, note the time again by chronometer.

Add these two chronometer times together and divide the sum by two. That will give the mean of the two times. To this mean apply the error and rate of the chronometer, and the result will be the Greenwich mean time of local apparent noon. With this Greenwich time, correct the equation of time from page II of the Nautical Almanac, and apply it to the Greenwich mean time, as directed at the head of the column from which the equation of time was taken, and that will give the Greenwich apparent time of local apparent noon.

If the Greenwich time is P. M., turn it into degrees, etc., and it will be the longitude in, and is named west.

If the Greenwich time is A. M., subtract it from twelve hours and turn the result into degrees, etc., and it will be the longitude, and is named east.

It will be noticed that the altitudes do not enter into the calculation, so do not apply any corrections to them.

12. Sumner's Method.

This observation is not, as some suppose, restricted to the use of the sun's altitude. Any two heavenly bodies may be used if their azimuths differ twenty degrees or so. It is often convenient and practicable to observe the altitudes of the sun and moon at the same instant or nearly so, and determine latitude, longitude and true azimuth at once. Two stars, one east and the other west of the meridian, give the desired result. However, so far, the examiner only requires the use of the sun.

The observed altitudes and chronometer times must be corrected the same as in the chronometer sight.

The latitude by account is given with instructions to assume latitudes a certain number of miles each side of it.

Take the first altitude and one of the assumed latitudes and find the longitude in the usual way. Name the calculation A, and place the longitude on the chart in the proper latitude and name it A.

Take the same altitude and the other assumed latitude, using the same polar distance, and find the longitude again. Name this calculation B, and place it on the chart in its proper latitude and name it B. Connect the two positions A and B by a line, and this will be the first line of position, and the ship is somewhere on that line. That is determined by the second line of position.

Now, take the second altitude, one of the assumed latitudes and the second polar distance and find the longitude as before. Name this calculation C, and place the longitude on the chart in its proper latitude and name it C.

Take the same altitude and polar distance and the other

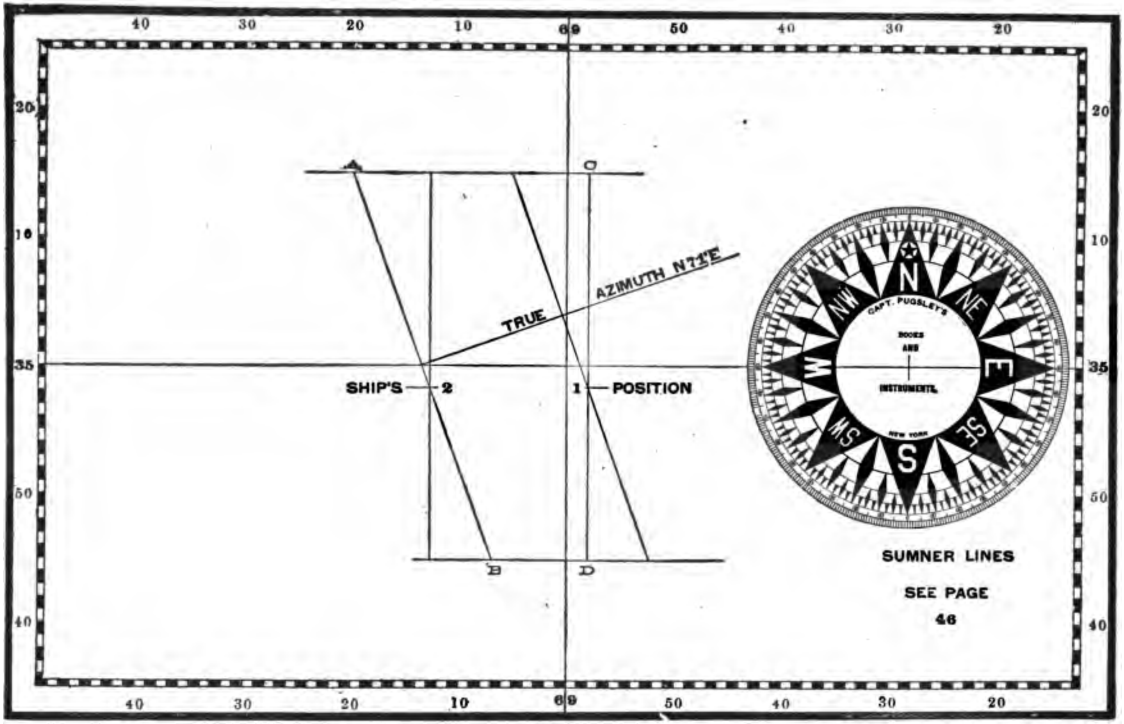
assumed latitude and determine the longitude again. Name this calculation D, and place the longitude on the chart in its proper latitude and name it D.

Join C and D by a line. If the ship has made no run since the first observation, the ship's position will be at the intersection of the two lines.

If the ship has sailed, move the first line of position east or west, as the case may be, a distance corresponding to the departure made.

It is possible, in case the latitude by account is greatly in error, and the assumed latitudes not being far enough away, that the two lines of position will not cross each other between the assumed latitudes. In that case it is only necessary to extend the lines until they do come in contact with each other. The azimuth is not affected by this circumstance.

When the lines of position are placed on the chart, the sun's true azimuth will be at right angles to these lines, on the side the sun is on. It may be determined by finding the true compass direction of the line, and the true azimuth will be ninety degrees different.



TRUE AZIMUTH N71°E
SHIP'S 2
1 POSITION
A
B
C
D
CAPT. PUGSLEY'S
BOOKS AND INSTRUMENTS.
NEW YORK
SUMNER LINES
SEE PAGE
46

16. Mercator's Sailing.

Place the latitude and longitude of the ship or place from which the course and distance is required and under them place the latitude and longitude of the place to which the course and distance is wanted.

Enter Table 3 and take out the meridional parts corresponding to each latitude.

If the latitudes are both north, or both south, subtract the lesser from the greater. If one latitude is north and the other is south, add them together, and the result will be the difference of latitude.

The same rule applies to the management of the meridional parts to obtain the meridional difference of latitude.

If the place to which the course and distance is wanted is south of the place to be sailed from, the difference of latitude and the meridional difference of latitude will be named south. If the place is north, they will be named north.

If the longitudes are both east or both west, subtract the lesser from the greater. If one longitude is east and the other is west, add them together, and the result will be the difference of longitude. If the sum of the longitudes should exceed one hundred and eighty degrees, subtract it from three hundred and sixty degrees. In this case, the difference of longitude will take the same name as the longitude of the place from which the course and distance is wanted.

Enter Table 2 with the meridional difference of latitude in the latitude column, and the difference of longitude in the departure column.

If the meridional difference of latitude is greater than the difference of longitude, read from the top of the page. If it is less than the difference of longitude, read from the bottom of the page. Where these two elements are found to agree, the course is found at the top or bottom of the page, according to which end of the page is being used.

The course is named the same as the difference of latitude and the difference of longitude.

On the same page where the course is found, find the proper difference of latitude in the latitude column, and the corresponding number in the distance column will be the required distance.

There is another method of performing this calculation which is not so convenient, as it requires the use of Tables 42 and 44. While this method is correct, its use at sea cannot be encouraged on account of the amount of labor and length of time required to obtain the desired result.

The method described above is not exactly correct; but its error is very small in both course and distance, and is therefore sufficiently accurate to meet the requirements of the most skilled practical navigator, and is always accepted by the examiner.

41, 21. Deviation of the Compass by an Amplitude.

The amplitude is observed when the centre of the sun is on the horizon and the time noted by the ship's clock.

The ship's clock always shows local apparent time at sea. This time is corrected for any change of longitude due to the ship's run since last regulated. Sometimes the examiner will give the local apparent time, while at others he may give the local mean time with the longitude by account to find the Greenwich time. In some problems the Greenwich time is given with the local time and longitude. In that case only consider the Greenwich time, except to note if the local time is A. M. or P. M.

If the azimuth tables are used, neither of these times or the longitude will be required.

It must be remembered that the time resulting from applying the longitude to local apparent time is Greenwich apparent time.

If the longitude is applied to local mean time, the result will be the Greenwich mean time. If the longitude is west, add it to the ship's time to obtain the Greenwich time; if the longitude is east subtract it. If the ship's time is not great enough to subtract from, add twelve hours to it.

Having obtained the Greenwich time, take the declination and hourly difference from page II of the Nautical Almanac if it is mean time. If it is apparent time, use page I of the Almanac.

If the Greenwich time is P. M., multiply the hourly difference by it, and the product will be the correction

to be added to the declination if increasing, and subtracted if decreasing.

If the Greenwich time is A. M., it must be subtracted from twelve hours, which will give the time from Greenwich noon, and with it multiply the hourly difference, and the product will be the correction to be subtracted from the declination if increasing, and added if decreasing.

From Table 44 take the logarithm secant for the latitude, and the logarithm sine for the declination. Add these two logarithms together, and the result will be the logarithm sine of the true amplitude.

If the ship's time is A. M., name the true amplitude east; if P. M., at ship, name it west. Name the other end of the true amplitude the same as the declination—north or south.

An amplitude is always reckoned from the east or west towards the north or south.

Enter Table 40 with the latitude and declination and take out the corresponding correction and apply it to the observed amplitude by the following rule.

At Rising in N. Lat. }
Setting in S. Lat. } apply the correction to the right.

At Rising in S. Lat. }
Setting in N. Lat. } apply the correction to the left.

The result will be the compass amplitude.

Place the compass amplitude under the true amplitude.

If they are both north or both south, subtract one from the other, and the remainder will be the compass error.

If the amplitudes are of different name—one north and

the other south—add them together and their sum will be the compass error.

If the true amplitude is to the right of the compass amplitude, the error is east.

If the true amplitude is to the left of the compass amplitude, the error is west.

If the variation and compass error are of different name add them together, and their sum will be the deviation and takes the same name as the compass error.

If the variation and compass error are of the same name, their difference will be the deviation. Looking toward the north point of the compass in this case, the deviation is named east when the compass error falls to the right of the variation, and west when it falls to the left.

The method described above is the one which the examiner would probably prefer; but its use cannot be recommended for practical work. Its accuracy cannot be questioned; but the practical navigator can very rarely use more than the nearest degree of the result. However, the method should be thoroughly understood, that it may be utilized when the azimuth tables are not available.

Instead of computing the true amplitude, it may be taken from Table 39, or any azimuth table. It would be better for the applicant to use the azimuth table.

If an azimuth table is used, subtract the azimuth from ninety degrees when it is less than ninety degrees.

If more than ninety degrees, subtract ninety degrees from it, and the result will be the true amplitude.

When the declination is 0°, the true amplitude will

be east or west, according if the local time is A. M. or P. M.

If the latitude is 0°, the corrected declination will be the true amplitude.

If Table 39 or the azimuth tables are used, it is not necessary to find the Greenwich time or to correct the declination or to use the correction from Table 40.

In practice, the amplitude of the sun is observed when its lower limb is about sixteen minutes or its semi-diameter above the horizon, which is equivalent to observing the center when on the horizon and applying the correction from Table 40.

57, 58 and 59. HURRICANES.

Bearing of Center and Rules for Avoiding It.

From U. S. Coast Pilot.

When the weather and the barometer indicate the approach of a hurricane, face the wind; the center will then bear 8 points to the right from the direction of the wind (at a considerable distance from the center, and before the barometer has fallen much below the normal, the center may bear 10 or 12 points to the right of the wind direction). Having the bearing of the center, shorten sail, or heave-to, and closely watch the barometer and the direction in which the wind shifts. In speaking of the shift of wind, such a shift is meant as would be observed on a vessel hove-to; for, if the vessel be moving faster than the storm (which is easily possible), and in the same direction, the observed shift may be contrary to what it would be if the vessel were hove-to.

If the wind shifts with the hands of a watch, the vessel is in the right semicircle of the hurricane. The vessel should then be hauled by the wind on the starboard tack and sail carried as long as possible; if obliged to heave-to, do so on the starboard tack.

If the wind shifts against the hands of a watch, the vessel is in the left semicircle of the hurricane; the wind should be brought on the starboard quarter, the direction of the vessel's head noted, and that course steered. If obliged to heave-to, do so on the port tack.

If there is no perceptible change in the direction of the wind but it increases in violence, with a falling barometer,

the vessel is directly in front, and on the track, of the storm. The vessel should be put before the wind, the direction of her head noted, and that course steered, trimming sail as the wind shifts to the starboard quarter. If obliged to heave-to, do so on the port tack.

If there is no perceptible change in the direction of the wind and it is moderating, with a rising barometer, the vessel is on the storm track but in rear of the center. In this case the safest rule is to run out with the wind on the starboard quarter, or heave-to on starboard tack. Advantage can be taken of favorable wind, but the greatest care must be exercised to avoid running into the storm. (See also remarks following.)

When looking in the direction in which the storm is traveling, the dangerous semicircle is on the right hand side of the storm track; in other words, the semicircle in which the wind shifts with the hands of a watch is the more dangerous part of the storm, and for the following reasons: Because the progressive movement of the storm increases the velocity of the wind in the right semicircle (the velocity of the wind in the left semicircle being correspondingly decreased); because both wind and current tend to carry the vessel in front of the storm, and if obliged to scud she will drive into greater danger; and because the right side is the one toward which the storm track is liable to recurve at any time.

In some cases vessels may, if the storm be traveling slowly, sail from the dangerous semicircle across the front of the storm and out of its influence. But, as the rate at which the storm travels along its track is uncer-

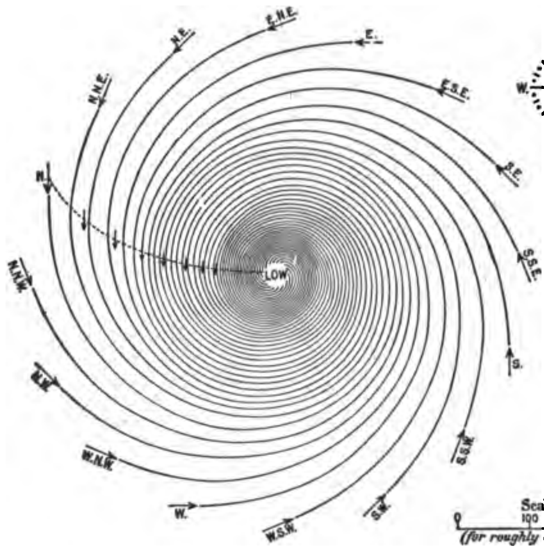
tain, this is an extremely hazardous undertaking; the mariner should carefully consider all the circumstances, particularly the rate at which the barometer is falling, before he attempts to cross.

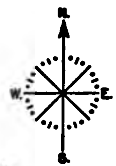
WEST INDIAN HURRICANES.

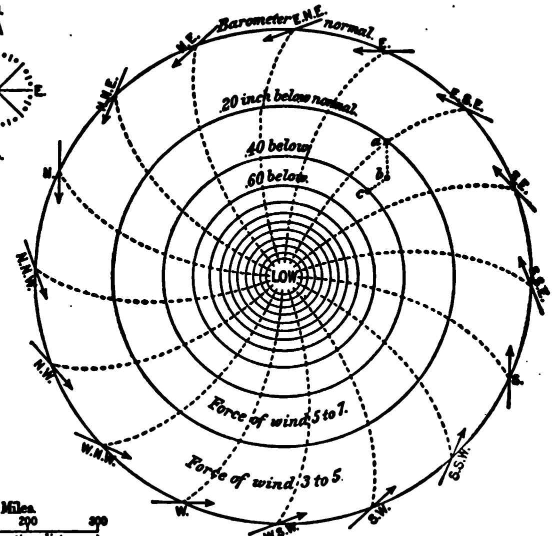
(From the Pilot Chart of the North Atlantic Ocean, September, 1887.)

DIAGRAM A.—Illustrating the circulation of the wind towards and around the center of low barometer in a tropical cyclone, northern hemisphere. The dangerous winds occur in the inner whirls.

DIAGRAM B.—For practical use in finding a ship's position relative to the center of a tropical hurricane, northern hemisphere, by means of the direction of the wind and fall of the barometer.







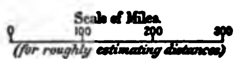


Diagram A.

The spiral lines illustrate the circulation of the wind in a tropical cyclone, northern hemisphere. The diameter of the area represented may vary in different storms and in different latitudes from about 100 to about 800 miles, and is generally least in low latitudes. The air is drawn in toward the center of low barometer, gradually takes up a more and more nearly circular path as its velocity increases, and finally whirls around the center with hurricane force. At the center is a calm spot from 10 to 30 miles in diameter; this is marked LOW, and here the lowest barometer reading is obtained. It will be noticed how similar the motion is to that of water in a whirlpool or eddy, and very naturally, as this is nothing but a gigantic whirlpool in the atmosphere, with the suction or draft at the center upward instead of downward. The direction of the wind at any point on this diagram is the same as the direction of the curve at that point, and the arrows show this direction at the points where they are plotted. By plotting arrows at all points having the wind from the same direction, north, for example, and joining them by a dotted line, we find that this dotted line curves toward the center, as shown. The angle of bearing of the center therefore gradually decreases from about 10 points to about 8 points in the inner whirls, where the well-known "8-point rule" becomes true.

Diagram B.

Here dotted lines are drawn from each wind-arrow at the margin to the center, in the way shown above, so that

to find a direction of the wind at any point follow the dotted line out to the margin and read it there. The circles are ISOBARS, and the barometer falls .20 inch as you go from one of these circles to the next inner one. This illustrates very clearly the rate at which the barometer falls as you approach the center—at first slowly, as the broad outer ring is traversed, then more and more rapidly. Near the center, where the isobars are very close together, it has been known to fall an inch in fifty miles. Of course as you recede from the center the barometer rises .20 inch as you pass from one isobar to the next outer one, just as it fell on entering the hurricane. This diagram involves as much of our latest knowledge of cyclones as can be safely used as a general guide, and extends out beyond the regions where the barometer is falling rapidly and the wind and sea have become violent. No attempt will be made to draw up a set of rules for action, but only to indicate how to plot your position on the diagram and obtain from it the probable bearing and distance of the center and the track and velocity of the storm, leaving it to yourself to decide what action to take, having proper regard to the strength and speed of your ship, the lay of the land, and the passage you are making.

Practical Use of Diagram B.

Suppose that at 4 P. M., for instance, the wind is ESE. and the barometer .20 inch below the normal: Find at the margin of the diagram the wind-arrow marked "ESE.," and follow the dotted line in toward the center as far as the isobar marked ".20 inch below normal"; this

intersection (marked *a*) is your position on the diagram; for, by the method of construction just explained, this is the place, and the only place, where the wind is ESE. and, at the same time, the barometer .20 inch below the normal. Referring to the compass and scale which accompany the diagram, you will find that the center (LOW) bears SW. by S., distant 250 miles. Plot this 4 P. M. position of the center on your track chart from the 4 P. M. position of your vessel.

Later in the day, say 8 P. M., suppose that the wind is SE. by E., and the barometer is .30 inch below the normal (having fallen .10 during the interval): With this wind your position must be halfway between the dotted lines leading in toward the center from the arrows marked "SE." and "ESE." and with this barometer reading it must be halfway between the isobars marked ".20 inch below normal" and ".40 below"; it is therefore at the point marked *b*, and the center bears SW., distant 200 miles. Plot this 8 P. M. position of the cyclone center on your track chart, from the 8 P. M. position of your vessel.

You thus have the position of the cyclone center at 4 P. M. and at 8 P. M. plotted on your chart, and the line joining the two positions is the track of the center and distance it has moved in four hours.

Suppose, again, that at 10 P. M. the wind is still from SE. by E., but the barometer stands .40 inch below normal, having fallen .10 in two hours. Your position is now at the point marked *c* on the diagram, found by exactly the same course of reasoning as before, and the cen-

ter now bears SW., distant about 175 miles. Plot this 10 P. M. position of the cyclone center on your track chart, from the 10 P. M. position of your vessel. If you have been lying-to, this will evidently indicate that the storm's track has recurved, and that you are directly in front of the center. But no matter whether you have been lying-to or not, your vessel's track and position at any time, and the track and position of the cyclone center, are both plotted on your chart, and you can closely watch every change of relative position in order to avoid the center and dangerous semicircle of the hurricane.

67, 35. The Log and Line.

This instrument is now known as the "old-fashioned log" on account of the logs in use now, having taken its place generally; but strange as it may seem, the old method of ascertaining the speed is still in use on board some ships. While it is not so convenient as the instruments more generally used for the purpose, it gives the speed correctly at the time it is used.

With its many disadvantages, it has one important advantage over the logs now used. That is, owing to its simplicity, one can be very easily and quickly made in case the modern log could not be had; a circumstance that most any officer is liable to encounter, and for that reason it is necessary that every officer should know how to make and use the "old-fashioned log."

The contrivance is composed of the log chip, line, reel and glass. The second hand of a watch may be used in place of the glass.

The Log Chip.

This part of the instrument consists of a quadrantal piece of thin board about seven inches radius, the curved side of which is loaded with lead to make it float upright. One hole is in each corner of the chip, and through the upper one the log line is rove and knotted. Both ends of a piece of line about ten feet long the same size as the log line are rove through the two lower holes and form a bridle. Exactly in the middle of the bridle a toggle is seized and this toggle fits into a socket seized on to the

log line at the same distance from the chip as the toggle is.

The object of this toggle and socket is to reduce the labor of hauling the chip in, as the toggle will pull out as soon as the line is checked, which is done as soon as the glass runs out. The chip will then lie flat on the water and very little strain will be on the line.

The Time Glass.

The time glass may be for any number of seconds. Those used are fourteen, twenty-eight and thirty seconds. It is not uncommon to find a time glass in error a second or two, which may be determined by comparison with the second hand of a chronometer or watch. When the sand in the glass is dry, it will run faster than when damp. Usually it will be dry or damp according to the weather, a matter that must be considered.

The Log Line.

The line is marked off at certain intervals, the length of which depending on the number of seconds in the glass used.

Measuring from the chip, allow about fifteen fathoms for stray line, and put in a red rag as a mark. From this mark the knots are measured. Their lengths are as follows:

For a fourteen second glass, the length of a knot is twenty-three feet and seven and three quarter inches.

For a twenty-eight second glass, the length of a knot is forty-seven feet and three and one half inches.

For a thirty second glass, the length of a knot is fifty feet and eight inches nearly.

The line is measured and marked when wet and tested by frequent measurement.

Put one knot in the first mark, two in the second and so on. For half knots use a piece of cod line without any knots.

If the line is marked for a twenty-eight second glass and a fourteen second glass is used, it is only necessary to double the number of knots run out to get the speed.

The length of knot is found on page forty-eight, by using logarithms and the following shows the same result without their use.

The proportion is—As the number of seconds (3600) in an hour is to the number of feet (6080) in a nautical mile, so is the number of seconds (14, 28 or 30) in the glass to the number of feet in a knot.

Fourteen Second Glass.

```
             6080
               14
            -----
            24320
            6080
           ------
3600 ) 85120 ( 23.64
       7200      ×12
       -----     ----
       13120     128
       10800     64
       ------    ----
        23200    7.68 = 7¾ inches, nearly.
        21600
        ------
         16000
         14400
         -----
          1600
```

The length of a knot for a fourteen second glass is 23.64 feet = 23 feet 7¾ inches nearly.

Twenty Eight Second Glass.

```
             6080
               28
            -----
            48640
           12160
          -------
3600 ) 170240 ( 47.29
       14400      ×12
       ------     ---
        26240      58
        25200     29
        ------    ----
         10400    3.48 = 3½ inches, nearly.
          7200
          -----
          32000
          32400
          -----
            400
```

The length of a knot for a twenty-eight second glass is 47.29 feet = 47 feet 3½ inches nearly.

Thirty Second Glass.

```
               6080
                 30
3600 ) 182400 (   50.66
       18000      × 12
       ------     ------
         24000     132
         21600     66
         -----    ------
          24000   7.92 = 8 inches, nearly.
          21600
          -----
           2400
```

The length of a knot for a thirty second glass is 50.66 feet = 50 feet 8 inches, nearly.

This log is hove from the lee quarter and as soon as the red rag is on the taffrail, the glass is turned and the speed of the ship will be the number of knots run over the rail while the sand in the glass runs down.

The examiner does not as a rule require the applicant to perform this calculation. The answer to the question as given on page 29, is all that is necessary.

Compass Error and Deviation by Azimuth.

The observed altitude must be corrected for instrumental error, semi-diameter, dip, refraction and parallax. In practice, the time by the ship's clock is noted when the altitude is observed, and then by correcting time for the ship's run since last regulated, and apply the longitude by account by adding to the ship's time if west, and subtracting if east, the Greenwich time is found.

If the local mean time is given, the result of applying the longitude to it will be Greenwich mean time, and the declination must be taken from page II of the Nautical Almanac.

If the local apparent time is given, the result of applying the longitude to it will be Greenwich apparent time, and the declination must be taken from page I of the Nautical Almanac.

In some problems the Greenwich time is given with both the longitude and local time.

In that case disregard the local time except to note if A. M. or P. M., and longitude.

If the Greenwich time is P. M., multiply the hourly difference of the declination by it, and the product will be the correction to be added to the declination if increasing, and subtracted if decreasing.

If the Greenwich time is A. M., subtract it from twelve hours, which will give the time from Greenwich noon, and with it multiply the hourly difference, and the product will be the correction to be subtracted from the declination if increasing, and added if decreasing, and the result will be the correct declination.

In using the azimuth tables, only the local apparent

time is required, and if not given in the problem, it must be found from the elements that are given, and it may be necessary to use the equation of time, which must be corrected by the same rule given for correcting the declination. Mean time cannot be used in the azimuth tables.

The problem of finding the true azimuth may be included in the chronometer sight, as shown in the example on page 35 of this work. If it is, all the elements for finding the true azimuth by calculation or by the use of azimuth tables, are the same as used to find the longitude—that is, the same altitude, latitude and polar distance, etc.

Add together the polar distance, latitude and true altitude. Divide the sum by two and name the result the half sum. Take the difference between the half sum and the polar distance and call it the difference.

From Table 44 take out the logarithms as follows:

Latitude,	logarithm	secant.
Altitude,	"	secant.
Half sum,	"	cosine.
Difference,	"	cosine.

When the polar distance is greater than eighty-nine degrees, or in other words, when it is found at the lower left-hand corner of the page, do not make the mistake of using the miles in the right hand column of the page. Use the left-hand column. Always take the miles in every case from the column at which the degrees are found. It is not necessary to correct these logarithms for seconds (″) in this calculation.

Add these logarithms together and divide their sum by two, and the result will be the logarithm cosine of half the true azimuth.

Enter Table 44 with this logarithm and take out the degrees and miles corresponding to it. This will be half the true azimuth, and when multiplied by two will give the true azimuth.

Name the true azimuth north or south, the same as the latitude, and name the other end east if the local time is A. M., and west if P. M.

In taking half the true azimuth from Table 44 corresponding to the logarithm cosine, the degrees are always taken from the upper left hand corner or lower right hand corner of the page.

Having found the true azimuth, place the compass azimuth under it, and take their difference, which will be the compass error and is named by the following rule.

If the true azimuth is to the left of the compass azimuth, the error is west.

If the true azimuth is to the right of the compass azimuth, the error is east.

When the compass error and variation are of same name, their difference will be the deviation.

When the compass error and variation are of different names, their sum will be the deviation.

Looking toward the north point of the compass, the deviation is named east when the compass error falls to the right of the variation, and west when it falls to the left.

This method is correct, and would be preferred by the examiner; but by using the azimuth tables the applicant can save considerable time and labor, and as they are allowed it would be better to use them.

Stowage of Cargo.

The examiners do not have a regular list of questions on this subject; but they generally examine the applicant orally. However, the following information on the subject will give a proper answer to any question given the applicant at any such examination.

LOADING OR DISCHARGING.

Keep the ship on an even keel, and do not break out damaged cargo until surveyed.

LOADING.

Clean the hold, clear the limbers, scuppers, water courses and pump wells before any cargo is taken on board. When not working cargo, the hatches or gratings should be on, or there should be a rope around the hatch to prevent any one from falling into the hold. Where the coamings are sufficiently high, it is not necessary to take this precaution.

DUNNAGE.

Nine inches on the floor, fourteen inches in the bilge, three inches in the sides and two inches on the between decks.

Dunnage is placed fore-and-aft in the lower hold and athwartships in the between decks, that any water may have a free passage.

CASKS.

Stow fore-and-aft, bilge and cantline, bung up and

bilge free. Stow pipes three tiers high, puncheons four tiers, tierces six tiers and barrels eight tiers high.

Barrels are made with their heads vertical and the bung and hoop rivets in line.

TAR, OIL, ETC.

All such cargo should be under and clear of all cargo it could damage in case of leakage.

CASES.

The side of a case or box which bears the mark is known as the top and should be stowed that side up.

BALES.

Stow on their flat amidships, marks and numbers up, and on their edge in the wing with the marks inboard.

ACIDS.

Stow on deck, that they may be thrown overboard in case of leakage.

SPIRITS.

Stow where they will not be accessible during the voyage.

IRON.

Large shipments of railway or pig iron are stowed grating fashion, that the weight may be raised to prevent rolling. When stowed, tom it down.

Seamanship.

A list of questions regarding this subject has not been prepared, but the examiner will if in his judgment it is necessary, ask such questions of the applicant as may best prove his knowledge of and experience in sailing vessels.

Such questions are not given those whose sailing ship experience is sufficient and beyond doubt, and they are not given those who apply for steamship license only.

However, it would be a waste of time for an applicant to attempt to obtain a sailing ship license if he is not a sailor with proper experience.

Before requesting an examination, the applicant should be able to handle the problems and write the answers to the questions given in this work.

System of Buoyage Adopted in United States Waters.

The examiners sometimes ask questions of the applicant regarding this subject. However, it is matter that should fall within every officer's knowledge.

The following order is observed in coloring and numbering the buoys in United States waters, viz:

1. In approaching the channel, etc., from seaward, RED BUOYS, with EVEN NUMBERS, will be found on the STARBOARD side of the channel, and must be left on the STARBOARD hand in passing in.

2. In approaching the channel, etc., from seaward, BLACK BUOYS, with ODD NUMBERS, will be found on the PORT side of the channel, and must be left on the PORT hand in passing in.

3. BUOYS painted with RED and BLACK HORIZONTAL STRIPES will be found on OBSTRUCTIONS, with channel ways on either side of them, and may be left on either hand in passing in.

4. BUOYS painted with WHITE and BLACK PERPENDICULAR STRIPES will be found in MID-CHANNEL and must be passed close-to to avoid danger.

All other distinguishing marks to buoys will be in addition to the foregoing, and may be employed to mark particular spots, a description of which is given in the printed list of buoys.

Perches, with balls, cages, etc., will, when placed on buoys, be at turning points, the color and number indicating on what side they shall be passed.

Nun buoys, properly colored and numbered, are usually

placed on the starboard side, and can buoys on the port side of channels.

Day beacons, stakes, and spindles (except such as are on the sides of channels, which will be colored like buoys) are constructed and distinguished with special reference to each locality, and particularly in regard to the background upon which they are projected.

Wherever practicable, the towers, beacons, buoys, spindles, and all other aids to navigation, are arranged in the buoy list in regular order as they are passed by vessels entering from sea.

The positions of the buoys enumerated in the buoy list are shown on the charts of the United States Coast and Geodetic Survey, which are kept corrected from information furnished by the Inspectors of the Lighthouse Districts, for the changes in the aids to navigation rendered necessary from time to time to indicate the best channels.

In winter when whistling buoys, bell buoys, lighted buoys, can buoys, and nun buoys are in danger of being carried away by ice, they are taken up and replaced by spar or spar-shaped buoys.

White buoys are used to mark anchorages, dumping grounds, etc., and when so used are described in the Coast Pilot and buoy list for the district.

The use of a yellow buoy to mark a quarantine station is not uncommon.

(See illustration on next page showing symbols and abbreviations used on charts.)

Lighthouse .... ✱

Lighthouse on small scale chart • Old light tower .... •

Beacon, lighted .... ☆ Beacon, not lighted .... ▲

Spindle (or stake) .... ǀ add word Spindle if space allows

Lightship .... ✱

Anchorage .... ⚓ Wreck .... ++

Rock awash at low water .... ✱ Sunken rock .... +

Life Saving Station .... ✦ L.S.S. (T) .... signifies connection with telegraphic system.

Kelp ....

No bottom at 20 fathoms .... 20 etc

Red buoy ǫ or add word white or yellow as required.

Black buoy ....

Horizontally striped buoy ....

Perpendicularly striped buoy ....

Buoys with perch and square ....

Buoys with perch and ball ....

Lighted buoy .... ✱ in place of • , as .... etc.

Mooring buoy ....

Landmark, as Cupola, Standpipe, etc .... ○

Whirlpool .... ●

Tide rip ....

Current, not tidal, drift in knots as .... ⟶ 2.0 ⟶

" , flood, first quarter, drift in knots, as .... ——— 0.4 ——→

" " " , second " " " " " .... ——— 1.0 ——→

" " " , third " " " " " .... ——— 0.3 ——→

" , ebb, ... ——————— otherwise like flood.

INTERNATIONAL CODE.

This code consists of 27 flags, as follows : 2 burgees, 5 pennants, 19 square flags and the code pennant, making 27 in all, and are described as follows :

Code pennant, red and white in 5 alternate stripes.

Burgees.

A White—blue, in two vertical stripes.
B Red.

Pennants.

C White with red spot.
D Blue with white spot.
E Red—white—blue, in three vertical stripes.
F Red, with white right cross.
G Yellow—blue, in two vertical stripes.

Square Flags.

H White—red, in two vertical stripes.
I Yellow, with black spot in centre.
J Blue—white—blue, in three horizontal stripes.
K Yellow—blue, in two vertical stripes.
L Blue and yellow in four alternate checks.
M Blue, with white diagonal cross.
N Blue and white in sixteen alternate checks.
O Yellow and red in two diagonal stripes.
P Blue with white centre.
Q Yellow—Quarantine.
R Red with yellow right cross.
S White with blue centre.
T Red—white—blue in three vertical stripes.
U Red and white in four alternate checks.
V White with red diagonal cross.
W Blue—white—red in three borders.
X White, with blue right cross.
Y Yellow and red in ten diagonal stripes.
Z Black—yellow—blue—red, each color triangular shaped.

To open communication, show the ensign with the Code Pennant under it.

When using the Code Pennant as an Answering Pennant, hoist it by itself where best seen.

To Find Longitude by a Star.

In this observation, the altitude is observed and corrected the same as in that of the sun, except that in dealing with stars, parallax and semi-diameter are not taken into account because they are too small for consideration.

The time by chronometer is noted and corrected in the usual way. If the Greenwich time should be P. M., it is astronomical time as it stands. If it is A. M., add twelve hours to it and put the date back one day.

The declination is taken from pages 248, 249 or 250, of the Nautical Almanac, and if it has the sign +, it is north, and if the sign is —, the declination is south.

The declination requires no correction, and when taken from the Nautical Almanac, is at once applied to ninety degrees to obtain the polar distance.

From the same page of the Nautical Almanac from which the declination is taken, the star's right ascension will be found.

In this observation it is better to use the astronomical date, which is fully explained in dealing with the Pole Star.

From the last column on page II of the Nautical Almanac, take the sidereal time. Enter Table 9 with the Greenwich mean time of observation expressed astronomically, and take out the corresponding correction and add it to the above mentioned sidereal time. The result will be the correct sidereal time.

Add together the true altitude, latitude and polar distance, and divide the sum by two. The result will be the

half sum and from the half sum, subtract the true altitude to obtain the remainder.

Take from Table 44 the logarithms, the same as in the observation of the sun, and find the hour angle which must always be taken from the P. M. column of Table 44.

If the star is west of the meridian, add its right ascension to the hour angle; but if the star is east of the meridian, subtract the star's hour angle from the star's right ascension, and if the right ascension is too small, add twenty-four hours to it, and the result will be the right ascension of meridian. From the right ascension of meridian, subtract the corrected sidereal time or right ascension of mean sun; but if the right ascension of meridian is too small, add twenty-four hours to it, and the result will be the local astronomical mean time at ship. The difference between the local astronomical mean time and Greenwich astronomical mean time will be the longitude in time, and this is turned into degrees, etc.

It is not probable that the examiners will give the applicant this problem, either to work or write about. However, they can if they wish to.

Latitude by Meridian Altitude of a Fixed Star.

The star's meridian altitude is observed. Correct it for instrumental error, dip and refraction which will give the true altitude. Subtract the true altitude from ninety degrees and the result will be the zenith distance and is named contrary to the star's bearing. If the zenith distance and declination from pages 248, 249 or 250, of the Nautical Almanac are both north or both south, add them together and their sum will be the latitude. If one is north and the other south, their difference will be the latitude and takes the name of the greater.

Among navigators it is customary to compute the time the desired star will pass the meridian and its approximate meridian altitude.

To find the time a star will pass the meridian, subtract the sun's right ascension, from page I of the Nautical Almanac, from the star's right ascension, and the result will be the local apparent time of the star's meridian passage. If the local mean time of the star's meridian passage is required, use the sidereal time from page II of the Nautical Almanac, instead of the sun's right ascension. If the star's right ascension is less than that of the sun, it must be increased by twenty-four hours.

To compute the meridian altitude, subtract the latitude by account from ninety degrees, which will give the co-latitude. If the latitude and declination are of same name, add the declination to the co-latitude. If they are of different name, take their difference and the result will be the true meridian altitude. To this add the dip and refraction and apply the instrumental error contrary to

its sign, and the result will be approximately the altitude the observer will obtain. If the observed altitude is much different from the computed one, it is due to an error in the latitude by account.

It is not probable that the examiners will give the applicant this problem to either work or write about; but can if they wish to.

NORTH ATLANTIC OCEAN—BRITISH ISLANDS AND NEW YORK.

Steamship Routes.

Information has been received from the Cunard Steamship Company, Liverpool, that the principal British and Continental steamships will in future follow the following routes between the British islands and New York:

Outward routes.—From January 15 to August 15, both days inclusive, from Fastnet or Bishop rock, steer on a Great circle course (nothing to the southward) to cross the meridian of 47° W. in latitude 42° N. Hence, either by rhumb line or Great circle (or even north of Great circle if an easterly current is encountered) to a position south of Nantucket lightvessel, thence to Fire Island lightvessel when bound to New York, or to Five Fathom Bank south lightvessel when bound to Philadelphia.

From August 15 to January 14, both days inclusive, from Fastnet or Bishop rock, steer on a Great circle course (nothing to the southward) to cross the meridian of 49° W. in latitude 46° N., thence by rhumb line to cross the meridian of 60° W. in latitude 43° N., thence also by rhumb line to a position south of Nantucket lightvessel, thence to Fire Island lightvessel when bound to New York, or Five Fathom Bank south lightvessel when bound for Philadelphia.

Homeward routes.—At all seasons of the year, steer a course from Sandy Hook lightvessel, or Five Fathom Bank south lightvessel, to cross the meridian of 70° W., nothing to the northward of latitude 40° 10′ N.

From January 15 to August 23, both days inclusive, steer from latitude 40° 10′ N. and longitude 70° W. by a rhumb line to cross the meridian of 47° W. in latitude 41° N., and from this last position nothing north of the Great circle to Fastnet when bound to the Irish channel, or nothing north of the Great circle to Bishop rock when bound to the English channel.

From August 24 to January 14, both days inclusive, steer from latitude 40° 10′ N., longitude 70° W., to cross the meridian of 60° W. in latitude 42° N., thence by rhumb line to cross the meridian of 45° W. in latitude 46° 30′ N., and from this last position nothing north of the Great circle to Fastnet when bound to the Irish channel, and as near as possible to, but nothing to the northward of, the Great circle to Bishop rock, always keeping south of the latitude of Bishop rock when bound to the English channel.

HYDROGRAPHIC OFFICE.

December, 1898.

EXTRACT OF THE

GENERAL RULES AND REGULATIONS

PRESCRIBED BY THE

BOARD OF SUPERVISING INSPECTORS

RULE III.—LIFEBOATS.

Drawings, Specifications, Name Plate.

1. Builders of lifeboats shall furnish the Supervising Inspector-General with drawings and specifications showing and explaining the construction of the same, and the physical characteristics (tensile strength and ductility) of the metal used. They shall also affix a plate or other device to each boat, having thereon the builder's name, number of boat, date of construction of boat, cubical contents of boat, and number of persons said boat will carry, as determined by the rules of the Board of Supervising Inspectors.

This section shall apply to all boats built after June 30, 1905.

Construction.

2. All lifeboats shall be substantially built.

Metallic lifeboats of 20 feet length and under shall be constructed of metal of not less thickness than No. 18 wire gauge. Boats 20 to 24 feet in length shall have a thickness of metal not less than No. 16 wire gauge for their middle half length, and their ends of not less than No. 18 wire gauge. Boats longer than 24 feet shall be built according to specifications approved by the Supervising Inspector-General. The wire-gauge numbers given in this paragraph are Birmingham standard.

The air tanks of all metallic lifeboats built after June

30, 1906, shall be provided with air-pump connections of one-half inch outside diameter, for the purpose of testing the air-tightness of said tank.

All seams and joints shall be properly double riveted.

All lifeboats shall have air-tight tanks of sufficient capacity to float boats when full of water and when loaded to allowed capacity.

Only countersunk-headed rivets shall be used in the construction of metallic lifeboats.

The above provisions of this section shall take effect only as to boats constructed after June 30, 1905.

All joints of the air tanks shall be both riveted and soldered.

All metallic lifeboats hereafter built shall be furnished with an automatic plug.

Equipments Required on Lifeboats.

3. All lifeboats shall have the following equipment: A properly secured life line the entire length on each side, and such line must be festooned with a seine float in each bight, the bights to be not longer than 3 feet; at least 2 life-preservers, or wooden life floats where the same are allowed by law; 1 boat painter of not less than 2¾-inch manila rope (about .9 inch diameter), properly attached and of a suitable length; a full complement of oars, and 2 spare oars of suitable length; not less than 4 rowlocks and 2 spare ones, all attached to the boat; 1 steering oar, with rowlock or becket, or 1 rudder, with yoke and suit-

able yoke ropes; 1 boat hook, and 1 bucket with lanyard attached, and on wooden boats 2 plugs for each drain hole, attached with lanyard or chain.

Lifeboats required on ocean vessels of 150 gross tons and over shall be equipped with 2 life lines, a painter, rudder, yoke, and yoke ropes, as already specified in this section, also a full set of oars and rowlocks, 1 spare oar and rowlock, 1 steering oar, with rowlock or becket, 2 boat hooks, 1 bailer, 1 bucket; 1 lugsail, with sheet, tack, and reef earings, in a water-tight canvas bag; 1 mast and 1 yard, with necessary rigging, 1 boat compass, 1 lantern, 1 gallon can of illuminating oil, at least 1 box of matches wrapped in a waterproof package and carried in a box attached to the underside of the stern thwart, 1 breaker of fresh water of at least 15 gallons' capacity, 1 sealed tin containing 25 pounds of hard bread, 1 waterproof canvas bag 6 inches diameter and 15 inches long containing palm and needles, sail twine, marline, marline spike, hatchet, smoker's flint and steel, a small bottle of spirits of turpentine for priming lantern wicks. Every such lifeboat shall also be provided with 6 night distress signals in a metallic case.

Distress signals, when fired by friction devices, are allowed when stowed in metal cases and protected by cotton at the end and so arranged as to be reversible before applying friction.

Provided, That, on all pleasure steamers and on all other steamers of over 150 gross tons, but not exceeding 750 gross tons, limited by their certificates of inspection to routes of not more than 15 miles from any harbor, on

the ocean, the lifeboats of 180 cubic feet capacity and over shall be equipped as required for lifeboats on ocean vessels, and all lifeboats of less than 180 cubic feet capacity on steamers referred to in this proviso shall be equipped as required in the first paragraph of this section for all lifeboats.

4. All lifeboats shall be fitted with such davits and gear as will enable the boats to be safely launched in less than two minutes from the time the clearing away of the boats is begun.

All lifeboats on vessels carrying passengers for hire must, if practicable, be carried under substantial davits or cranes; but if it is not practicable so to carry all the lifeboats required, the remainder must be stowed near at hand, so as to be easily and readily launched.

All boats under davits must be arranged so that they can be simultaneously launched. Each lifeboat carried under davits must be provided with two separate davits. When a single crane is properly adapted to lower a lifeboat, it may be allowed to take the place of the two davits. Such davits or cranes, and the blocks and the falls thereof, on all passenger vessels except ferryboats, must be of sufficient strength to carry the boat with its full load.

It shall be the duty of the master or officer in charge of all such vessels to see that the boat davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat davit falls on all boats not swung out at boat drills shall be cut adrift and overhauled; and it shall be unlawful to stow in any life-

boat articles other than those required by law and regulations.

Lifeboats must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year. All lifeboats shall have their cubical contents painted on the stem in black letters and figures not less than three-fourths of an inch high on a white ground.

The lifeboat referred to in the table [sec. 13, Rule III] for passenger steamers of 10 tons or under must be either carried or towed at all times when being navigated with passengers on board.

Carrying Capacity and Size of Lifeboats.

5. The capacity of all lifeboats shall be determined by the following rule: Measure the length and breadth outside of the planking or plating and the depth inside at the place of minimum depth. The product of these dimensions multiplied by .6 resulting in the nearest whole number shall be deemed the capacity in cubic feet.

To determine the number of persons a boat is to carry, divide the result by 10 for ocean, lake, bay, and sound steamers, and for river steamers divide the result by 8: *Provided, however,* That such boats shall in all cases have sufficient room, free board, and stability to safely carry such number of persons, which fact must be determined by actual experiment in the water at the time of the first inspection of said boats after the passage of this rule, Where a vessel is carrying boats of different types or capacities, at least one boat of each type or capacity shall be so tested.

The carrying capacity of a boat 20 feet in length, 6 feet in breadth, and 2 ½ feet in depth will be determined as follows:

For ocean, lake, bay, and sound steamers.

$$\frac{20 \times 6 \times 2\frac{1}{2} \times .6}{10} = \frac{180}{10} = 18 \text{ persons.}$$

For river steamers, same boat, $\frac{180}{8} = 22$ persons.

Lifeboats required on ocean vessels of 150 gross tons and over shall be of suitable dimensions and of not less than 180 cubic feet capacity.

Provided, That all pleasure steamers, and all other steamers over 150 tons but not exceeding 750 tons, limited by their certificates of inspection to routes not more than 15 miles from any harbor, shall not be required to have more than one of the lifeboats to be of 180 cubic feet capacity. Nothing, however, in this proviso shall exempt any such steamer from carrying the aggregate cubic feet of lifeboat capacity provided for by the tables.

Provided further, That the supervising inspector of the district may, in exceptional cases, permit lifeboats of less than 180 cubic feet as a substitute for said boat on steamers where the crew is insufficient to properly handle a boat of that size, or where there is lack of space to properly carry so large a lifeboat, but in every such case the steamer must be provided with one or more lifeboats efficient in character and large enough to carry every person on board.

Lifeboats Required.

6. *Lifeboats required on vessels of 50 gross tons or over not carrying passengers for hire.*

All vessels of 50 gross tons or over not carrying passengers, navigated under the provisions of Title LII, Revised Statutes of the United States, shall at all times be equipped with sufficient boat capacity to carry the crew of said vessel with safety, capacity to be determined by the rules of the Board of Supervising Inspectors: *Provided,* That steamers of less than 150 tons gross, while engaged exclusively in harbor towing, may substitute one or more life rafts for the lifeboats required, when the lifeboats interfere with the practical operation of the steamer, and such substitution may be made with safety, it being understood that when such vessel engages in service other than harbor towing she must be equipped with boats as required by the rules and regulations.

7. *Boats required on vessels of less than 50 gross tons not carrying passengers for hire.*

All vessels of less than 50 gross tons, navigated under the provisions of Title LII, Revised Statutes of the United States, and not carrying passengers, must be equipped with boats or rafts as in the opinion of the inspectors may be necessary to secure the safety of all persons on board in case of disaster.

8. *Lifeboats required on vessels carrying passengers for hire, fire boats, stern-wheel towboats. Working boat and metal lifeboat.*

All vessels inspected under the provisions of Title LII,

Revised Statutes of the United States, carrying passengers for hire, shall be required to be provided with lifeboats according to the following tables: *Provided,* That no vessel shall be required to have more lifeboat capacity than sufficient to carry all the passengers and crew allowed by the certificate of inspection. And at least one lifeboat shall be of metal, unless exempted by the supervising inspector of the district where the vessel was last inspected: *It is further provided,* That all such vessels of 50 gross tons and upward must have one working boat in addition to the lifeboats required: *Provided,* That all steamers that are used exclusively as fire boats and connected or belonging to a regularly organized fire department shall not be required to carry the lifeboats required by the following tables, but shall be required to carry such boats or rafts as in the judgment of the local inspectors or supervising inspectors may be necessary to carry the crew: *Provided,* That stern wheel towboats engaged exclusively in the business of towing shall not be required to carry the boats technically known as lifeboats, described in this Rule III, or metallic lifeboats, but shall be required to carry such boats only as, in the judgment of the local inspectors, will, by their number, capacity, character, and equipment, fully provide for the safety of the crew of the vessel.

9. *Cubical capacity of lifeboats required on passenger vessels navigating rivers other than the Red River of the North, rivers whose waters flow into the Gulf of Mexico, and the Yukon River and other similar rivers, the bars and channels of which are liable to sudden changes, except vessels of 150 gross tons and under, hereinafter provided for.*

	Cubic feet
Vessels over 150 and not over 300 gross tons	360
Vessels over 300 and not over 600 gross tons	540
Vessels over 600 and not over 900 gross tons	720
Vessels over 900 and not over 1,200 gross tons	900
Vessels over 1,200 gross tons	1,080

10. *Cubical capacity of lifeboats required on passenger vessels navigating the Red River of the North, rivers whose waters flow into the Gulf of Mexico, the Yukon and other similar rivers, the bars and channels of which are liable to sudden changes, excepting vessels of 150 gross tons and under, hereinafter provided for.*

	Cubic feet
Vessels over 150 and not over 300 gross tons	240
Vessels over 300 and not over 600 gross tons	360
Vessels over 600 and not over 900 gross tons	480
Vessels over 900 and not over 1,200 gross tons	600
Vessels over 1,200 gross tons	720

11. *Cubical capacity of lifeboats required on passenger vessels navigating northwestern lakes, bays, and sounds, except vessels of 150 gross tons and under, hereinafter provided for.*

Gross tons.	Capacity of boats.	Gross tons.	Capacity of boats.
Vessels over—	*Cu. feet.*	Vessels over—	*Cu. feet.*
150 and not over 200	360	2,000 and not over 2,500	1,620
200 and not over 300	540	2,500 and not over 3,000	1,800
300 and not over 400	720	3,000 and not over 3,500	1,980
400 and not over 500	900	3,500 and not over 4,000	2,160
500 and not over 1,000	1,080	4,000 and not over 4,500	2,340
1,000 and not over 1,500	1,260	4,500 and not over 5,000	2,835
1,500 and not over 2,000	1,440	5,000 and not over 5,500	3,330

Steamers above 5,500 gross tons shall be furnished with an additional boat of not less than 495 cubic feet capacity for each additional 500 tons burden or fraction thereof.

12. *Cubical capacity of lifeboats required on passenger vessels navigating oceans, except vessels of 150 gross tons and under, hereinafter provided for.*

Gross tons.	Total capacity of boats.	Gross tons.	Total capacity of boats.
Vessels over—	*Cu. feet.*	Vessels over—	*Cu. feet.*
150 and not over 200.......	540	9,500 and not over 10,000...	7,920
200 and not over 300.......	720	10,000 and not over 10,500...	8,145
300 and not over 400.......	1,080	10,500 and not over 11,000...	8,370
400 and not over 500.......	1,260	11,000 and not over 11,500...	8,595
500 and not over 1,000......	1,620	11,500 and not over 12,000...	8,820
1,000 and not over 1,500.. ...	1,800	12,000 and not over 12,500...	9,045
1,500 and not over 2,000......	2,160	12,500 and not over 13,000...	9,270
2,000 and not over 2,500......	2,340	13,000 and not over 13,500...	9,495
2,500 and not over 3,000......	2,700	13,500 and not over 14,000...	9,720
3,000 and not over 3,500......	2,880	14,000 and not over 14,500...	9,945
3,500 and not over 4,000......	3,240	14,500 and not over 15,000...	10,170
4,000 and not over 5,000......	3,420	15,000 and not over 15,500...	10,395
5,000 and not over 5,500......	3,870	15,500 and not over 16,000...	10,620
5,500 and not over 6,000......	4,320	16,000 and not over 16,500...	10,845
6,000 and not over 6,500......	4,770	16,500 and not over 17,000...	11,070
6,500 and not over 7,000......	5,220	17,000 and not over 17,500...	11,295
7,000 and not over 7,500......	5,670	17,500 and not over 18,000...	11,520
7,500 and not over 8,000......	6,120	18,000 and not over 18,500...	11,745
8,000 and not over 8,500......	6,570	18,500 and not over 19,000...	11,970
8,500 and not over 9,000.....	7,020	19,000 and not over 19,500 ..	12,195
9,000 and not over 9,500......	7,470	19,500 and not over 20,000...	12,420

Vessels of over 20,000 gross tons shall be provided with an additional boat capacity of 225 cubic feet for each additional 500 gross tons, or fraction thereof.

13. *Cubical capacity of boats required on passenger vessels of 150 gross tons and under navigating oceans, lakes, bays, sounds, and rivers.*

	Cubic feet
Vessels not over 10 gross tons...........................	75
Vessels over 10 and not over 30 gross tons................	90
Vessels over 30 and not over 50 gross tons................	120
Vessels over 50 and not over 100 gross tons..............	135
Vessels over 100 and not over 150 gross tons..............	165

14. Not more than one-third of the lifeboat capacity required on any vessels may be substituted by its equivalent in approved life rafts or approved collapsable (folding) lifeboats.

15. *Lifeboat not required on steam vessels of 5 gross tons or less used for pleasure purposes only.*

All open steam launches or other steam vessels of 5 gross tons or less, used for pleasure purposes only, shall not be required to carry a lifeboat.

Lifeboats and Other Equipment Required on Sail Vessels.

16. Local inspectors inspecting sail vessels, carrying passengers on the ocean or on the high seas, under the provisions of section 4417, Revised Statutes, as amended by the act of Congress approved March 3, 1905, shall require such sail vessels to be equipped with a life-preserver for every person on board, passengers and crew, and with lifeboats, in accordance with the requirements of the rule applying to ocean steamers carrying passengers.

Boats and Other Equipment Required on Barges.

17. Barges carrying passengers on any routes shall have a life-preserver or float for each and every person allowed to be carried, and in addition thereto shall be supplied with 10 buckets, 2 barrels of not less than 40 gallons each, and 3 axes, 1 hand fire pump capable of discharging 100 cubic inches of water at each stroke, and sufficient length of regulation hose to reach to all parts of

the vessel, and 2 yawl boats of not less than 120 feet capacity each, equipped with 4 oars each.

All barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high.

LIFE RAFTS.

Drawings, Specifications, Name Plate, and How Marked.

18. Builders of life rafts shall furnish the Supervising Inspector-General with drawings and specifications showing and explaining the construction of the same, and the physical characteristics (tensile strength and ductility) of the metal used. They shall also affix a plate or other device to each raft, having thereon the builder's name, number of raft, date of construction of raft, cubical contents of raft, and number of persons said raft will carry, as determined by the rules of the Board of Supervising Inspectors. This paragraph shall apply to all rafts built after June 30, 1905.

There shall be stenciled in a conspicuous place on each life raft now in use the number of persons said life raft can carry, as hereinafter provided.

Construction.

19. All life-raft cylinders of more than 15 feet in length or of more than 16 inches in diameter shall be constructed of metal not less than No. 18 Birmingham wire gauge. No life-raft cylinders shall be of less thickness of metal than No. 20 Birmingham wire gauge.

The retaining bands which secure the cylinders to the

frames shall be made in halves so that the cylinders may be detached without difficulty for the purpose of inspection, cleaning, and painting, as required by this section.

All life-raft cylinders, except those 6 feet or less in length, must be divided by water-tight bulkheads into not less than three compartments of equal lengths, and each compartment shall be provided with a suitable air-pump connection, of one-half inch outside diameter, fitted with air-tight cap.

The inspection of a metallic cylindrical life raft will include the testing of each compartment by air pressure.

Only countersunk-headed rivets shall be used in the construction of metallic life rafts.

All seams and joints shall be properly double riveted.

The above provisions of this section shall take effect only as to life rafts constructed after December 31, 1908.

The circumferential as well as the longitudinal seams of life-raft cylinders must be riveted, and on rafts constructed after June 30, 1905, shall also be soldered.

The framework connecting the cylinders of metallic life rafts must be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in surf or seaway.

Life rafts must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year.

Equipments Required on Life Rafts.

20. All life rafts must be equipped with 2 life lines, securely fastened to the gunwales; 1 painter, of 2¾-inch manila rope of a suitable length; not less than 4 oars of

suitable size; 2 paddles, each of not less than 5 feet in length, the blade of each to be of not less area than one-half that of the blade of one of the oars of such raft; 4 rowlocks; 1 steering oar, with rowlock or becket, and 1 boat hook.

All the equipment mentioned in this section shall be kept in good condition for immediate use.

Capacity of Collapsible Boats, Carley Life Floats, and Life Rafts.

Engelhardt Collapsible Boats.

21. Twelve-foot boat, except when carried on davits, 17 persons.

Twenty-foot boat, except when carried on davits, 28 persons.

Carley Life Floats.

No. of float.	Size of float.	Diameter of tube.	Minimum number of compartments.	Number of persons carried and allowed.
		Inches.		
1	8 by 4 feet	14¼	....	10
2	8 by 5 feet	16¼	....	11
3	10 by 6 feet	17¼	....	18
4	12 by 8 feet	20¼	....	33
5	3 feet 6 inches by 6 feet	12	8	6
6	3 feet 9 inches by 6 feet 6 inches	13	8	7
7	4 by 7 feet	14	8	9
8	4 feet 6 inches by 7 feet 6 inches	14	10	11
9	4 feet 6 inches by 8 feet 6 inches	14	12	13
10	5 by 8 feet	14	12	13
11	5 by 8 feet	15	12	13
12	5 by 9 feet	15	14	16
13	5 by 10 feet	15	14	17
14	6 by 10 feet	16	....	28
16	6 feet 6 inches by 10 feet 6 inches	17	....	31
15	7 by 12 feet	18	....	41
17	8 by 12 feet	19	....	45
18	9 by 14 feet	20	....	67
19	5 by 8 feet	14½	....	18
20	5 by 10 feet	15½	....	20

Balso Wood Life Raft.

11 feet by 4½ feet, 12-inch cylinders, 7 persons.

Barstow Life Rafts.

Length of tank.	Width of tank.	Depth of tank.	Number of persons carried and allowed.
Feet.	*Feet.*	*Inches.*	
14	6	14	36
14	5	14	36
12	5	14	28
12	4	14	25
10	4	14	24
8	4	14	16
6	4	14	12
5	3	12	8

Cylinder Life Rafts, Approved Specifications.

Length over all.	Width outside of guards.	Diameter of cylinders.	Number of persons carried and allowed.
Ft. in.	*Ft. in.*	*Inches.*	
16 8	6 7½	22	28
16 6	5 8	16	16
14 0	5 6	16	14
12 2	5 7	16	14
8 0	5 2	16	7

22. Engelhardt collapsable lifeboats, Carley life floats, and the three kinds of life rafts specified in the preceding section, of different dimensions from the foregoing, may be tested by the supervising inspector of the district in which they are made, after their specifications have been approved by the Supervising Inspector-General, and allowed the number of persons which they actually carry

in said trial, the Supervising Inspector-General issuing a circular letter giving the rating allowed after trial of each new size.

The Engelhardt collapsable (folding) lifeboat shall be rated as a lifeboat when extended under the davits. One nest of two such lifeboats shall be allowed under one set of davits on steam vessels of 3,500 to 5,000 gross tons, and one nest of three such lifeboats shall be allowed on steam vessels of 5,000 gross tons and upward.

Engelhardt collapsable lifeboats shall be fully equipped as lifeboats as required by these rules and regulations, and shall be measured in accordance with the rules for measuring lifeboats (section 5, Rule III). The depth of the boat shall be taken from the inside of the bottom planking of the bottom. The cubical capacity thereof shall be determined by multiplying the length, breadth, and depth together, and multiplying that product by .7.

LIFE PRESERVERS.

23. Every vessel inspected under the provisions of Title LII, Revised Statutes of the United States, shall be provided with one good life-preserver, having the approval of the Board of Supervising Inspectors, for each and every person allowed to be carried on said vessel by the certificate of inspection.

Every life-preserver adjustable to the body of a person shall be made of good cork blocks or other suitable material approved by the Board of Supervising Inspectors, with belts and shoulder straps properly attached, and

shall be so constructed as to place the device underneath the shoulders and around the body of the person wearing it. All such life-preservers shall be not less than 52 inches in length when measured laid flat; and every cork life-preserver shall contain an aggregate weight of at least 6 pounds of good cork, and every life-preserver shall be capable of sustaining for a continuous period of twenty-four hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life-preserver of at least 20 pounds.

All life-preservers shall be covered with material of sufficient weight and strength to fully protect the contents, such material to be of a strength equivalent to unbleached cotton twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on each life-preserver shall be of one piece only, and the outside longitudinal edges of the covering at the seam must be turned to a roll and closely rope-stitched. Each life-preserver shall have two shoulder straps of heavy double-woven cotton tape 1¼ inches in width. Each strap shall be made of one piece only, and such straps shall be not less than 23 inches net in length, and shall be securely attached to the covering of the life-preserver by not less than four rows of stitching and at not less than two places for each strap, the rear ends of the straps to be sewed on not less than 3 nor more than 5 inches from the center of the upper edge of the jacket, measured to the center of the straps. The said shoulder straps shall be securely attached to each other by not less than four

rows of stitching at the point where they cross each other on the back, the forward ends to be sewed on the jacket in such a position as to allow it to be opened out to its full length without straining the cross seizing. There shall also be on each life-preserver a breast or button strap of heavy double-woven cotton tape 1 inch wide and 12 inches long, one end of which shall be securely fastened to one shoulder strap by four rows of stitching at a point 4 inches above the jacket, and the other end of such breast strap shall be doubled back 2 inches and a buttonhole worked through both parts. A button of non-corrosive material shall be securely sewed on the other shoulder strap 4 inches above the jacket. There shall also be on each life-preserver a belt of heavy double-woven cotton tape 1¼ inches wide, extending along the middle line on the outside of the jacket, securely sewed to the covering of the life-preserver at not less than six places, the end blocks being left free, and the ends of the belt to extend 12 inches beyond the ends of the jacket. All thread used in the construction of life-preservers must be linen of a size and strength not less than Barbour's three-cord No. 25 machine thread. All seams and other machine sewing on life-preservers shall be with a short lock stitch, not less than 8 stitches to the inch.

Blocks of compressed or consolidated cork when used in life-preservers must weigh in the aggregate not less than 6 pounds to each life-preserver, and must be so constructed that said blocks will sustain, without disintegration or substantial expansion, a submersion test satisfactory to the inspector examining the same, and that at

the expiration of such test must have the buoyancy above required. Where the blocks of life-preservers are made up of separate pieces of cork, said pieces shall be fastened with noncorrosive materials.

After the approval of this rule no life-preserver shall be passed at the factory inspection which does not fulfill the foregoing requirements, but life-preservers now in use or already passed at factory inspection may be used on board vessels, provided they are constructed in accordance with the laws and regulations in force up to the date of approval of this section, and are in good and serviceable condition: *Provided, however,* That nothing in this section shall be construed so as to allow the use after May 1, 1905, of life-preservers made of kapok or loose granulated cork: *Provided,* That all block-cork life-preservers now in use that have been approved by this Board shall be passed by the local inspectors when they are not less than 48 inches in length and have the other necessary requirements. Inspectors are further required to direct such life-preservers to be distributed throughout the cabins, staterooms, berths, and other places convenient for passengers on such steamers; and there shall be a printed notice posted in every cabin and stateroom and in conspicuous places about the decks, informing passengers of the location of life-preservers and other life-saving appliances, and of the mode of applying or adjusting the same. Life-preservers on passenger, excursion, and ferry steamers when stowed overhead must be so supported that they can be quickly released and distributed among the passengers, and the inspector must satisfy himself as

to the efficiency of the means used for such purpose by actual experiment. And when such life-preservers are stowed overhead at a height greater than 7 feet from the deck below efficient means must be provided for such immediate release and distribution, to be operated by persons standing on the deck below.

The supervising inspector of the district shall detail a local or assistant inspector to any place where life-preservers are manufactured, whose duty it shall be to test and examine all life-preservers manufactured at that place and satisfy himself that such life-preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination, and certifying that they have been examined and passed. When life-preservers are so stamped it shall be prima facie evidence that they comply with the requirements of law and regulations as to their original construction, and they may thereafter be accepted by inspectors, in their discretion, as being in accordance with the rules and regulations of the Board of Supervising Inspectors.

Use of Loose Granulated Cork Life-Preservers and Life Rafts and Kapok Life-Preservers Prohibited.

24. All life rafts and life-preservers made in whole or in part of loose granulated cork shall be excluded from use on all vessels.

All kapok life-preservers heretofore approved by this Board shall be excluded from use on all vessels.

Provided, That this section shall take effect on and after May 1, 1905.

Wooden Life Floats.

25. Vessels navigating rivers and carrying passengers shall be allowed to use wooden floats, when made as approved by the Board of Supervising Inspectors, one for each deck or steerage passenger.

When wooden life floats are used in accordance with the above paragraph, their dimensions shall be not less than 4 feet in length, 14 inches in breadth, and 2 inches in thickness. The floats shall be made of well-seasoned white pine or of any other wood not exceeding white pine in weight per cubic foot.

Ring Buoys.

26. Whenever they deem it necessary for the safety of passengers or crew, inspectors may require a vessel to carry, not to exceed four, ring buoys, either with or without attached lines. It is recommended that ring buoys hung on a steamer's gangways have the line attached to both the vessel and the buoy, and that those hung on the superstructure have no line and be as light as is possible with the necessary buoyancy.

Line-Carrying Guns, Rockets, and Projectiles.

27. All ocean steam pleasure vessels and ocean steam vessels carrying passengers, except vessels of 150 gross tons and under, shall be provided with at least three line-carrying projectiles and the means of propelling them,

such as may have received the formal approval of the Board of Supervising Inspectors.

All cast bronze guns of the Lyle type, approved by the Board of Supervising Inspectors, January, 1890, for use on board of steam vessels as a means of propelling line-carrying projectiles, shall be composed of an alloy which shall have a tensile strength of not less than 52,000 pounds per square inch of section and a ductility of not less than 26 per cent., as shown by reduction of area.

All Hunt's line-carrying guns, large; Hunt's line-carrying guns, small; Hunt guns No. 2, and Lyle line-carrying guns shall be tested in the presence of an inspector or assistant inspector by firing the same three rounds. One round, at least, must carry the regular service projectile, with a service line attached, a distance of at least 1,400 feet. The other two rounds must be fired with the same charge of powder, and the projectile must have the same weight as the service projectile, but no line need be attached.

Provided, That when the Hunt line-carrying gun, small, is tested, the distance the projectile must carry the line need not exceed 800 feet.

At least one sample of the material shall be taken from the casting of each gun, and shall be not less than 7 inches in length, 2 inches in width, ½ inch in thickness, and have a section .5 by .75 inch over a length of 2 inches.

All samples shall be furnished to the supervising inspector of the district for testing, and shall be accompanied by an affidavit of the manufacturer that such samples were taken from guns, each of which shall be

distinctly marked, so as to be readily identified by the inspectors.

28. When approved rockets are used instead of guns, there shall be, in every case, at least three of said rockets; and all steamers that are required under the law to carry line-carrying projectiles and the means of propelling them shall be supplied auxiliary thereto with at least 800 feet of 3-inch manila line for vessels of 100 to 500 gross tons and 1,500 feet of said line for steamers above 500 gross tons, such auxiliary line to be kept always ready for use in connection with the gun and rocket, and which lines shall not be used for any other purpose.

29. The test rounds required by section 27 must be fired from the gun when mounted on its own carriage, lashed as it would be in shipboard use. The line must be coiled, faked or reeled in its own faking box, or reel; and gun, carriage and line box, or reel, must all bear the same number, and must be initialed by the inspector, whose report, giving number, date, and result, will be filed in the office of the supervising inspector of the district in which the test is made.

30. The supervising inspector shall furnish the manufacturer of any Lyle or Hunt line-carrying guns a copy of the report on each gun tested and inspected, as provided in sections 27 and 29.

Drill Required with Line-Carrying Gun.

31. The master of every vessel equipped with a line-carrying gun shall drill his crew in the use thereof, and fire said gun at least once in every three months, using

one-half the usual charge of powder and any ordinary line of proper length.

It shall be the duty of the inspectors, at the annual inspection, to see that these drills are entered on the log of the vessels.

Drags or Floating Anchors.

32. Drags or floating anchors shall be constructed so as to be capable of being compactly stowed near the head of the ship.

Steamers navigating the ocean must be provided with at least one drag, of area as follows: For steamers of 400 gross tons or under, not less than 25 superficial feet; for steamers of over 400 gross tons, the area of drag shall not be less than that determined by adding to 25 square feet 1 square foot for each additional 25 gross tons above 400 tons. Example: The area of a drag on a vessel of 1,000 tons will equal:

$$25 + \frac{1,000 - 400}{25} = 49 \text{ square feet.}$$

Steamers of over 5,000 gross tons may be equipped with two or more drags, provided the total area is not less than that required by this rule. Steamers whose routes do not extend *off anchorage* are not required to have drags or floating anchors on board.

Extra Steering Apparatus, Ladders, Stairways.

33. Extra steering apparatus, consisting of relieving tackles or tiller, must be provided for all steamers.

Every steamer or barge carrying passengers shall be provided with suitable ladders, where practicable for use, to enable passengers to descend conveniently to the life-boats, such ladders to be placed near each side of the vessel.

Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with permanent stairways forward and aft, except where said stairways on towing boats would interfere with towing bitts.

Bulkheads.

34. Every seagoing steamer and every steamer navigating the great Northern and Northwestern lakes carrying passengers for hire shall have not less than three water-tight cross bulkheads. Such bulkheads shall reach to the main deck in single-decked vessels, otherwise to the deck next below the main deck. The bulkheads, however, shall in every case reach to the deck next above the load line. For wooden hulls they shall be fastened to suitable framework, which framework must be securely attached to the hull and calked. For iron hulls they shall be well secured to the framework of the hulls and strengthened by stiffeners of angle iron not less than 3½ by 3½ inches, placed not more than 2½ feet from center to center. And where bulkheads are more than 12 feet in depth they shall be strengthened by horizontal angle irons not less than 3 by 3 inches and spaced not less than 4 feet apart. One of the bulkheads shall be placed for-

ward and one abaft of the engines and boilers. The bulkhead abaft the engine room shall not be placed so far aft as to make it practically useless.

The third or collision bulkhead must be placed not nearer than 5 feet from the stem of the vessel. Iron bulkheads must be made not less than one-fourth of an inch in thickness, and wooden bulkheads must be of equal strength and covered with metal plates not less than one-sixteenth of an inch in thickness.

The covering of wooden bulkheads on the forward side of the one forward of the engines and boilers, and on the after side of the one abaft the engines and boilers, shall be at the discretion of the inspectors; but no discretion is allowed as to the covering on the sides next to the engines and boilers on bulkheads built after the approval of this rule (July 12, 1906).

Steamer's Name on Equipments.

35. All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life-preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used.

Definition of Passenger Steamer.

36. Wherever the words "passenger steamer," "steamer carrying passengers," or "vessel carrying passengers" occur in this entire rule (Rule III), the said words shall be construed to mean, and apply to, only vessels carrying passengers for hire, and the words "carrying passengers" shall be construed to mean "carrying passengers for hire."

RULE IV.—FIRE APPARATUS.

1. All steamers carrying passengers are required to be provided with fire buckets, barrels, and axes, as follows:

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons	....	2	1
All steamers over 10 tons and not over 25 tons	....	4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons	2	18	4
All steamers over 200 tons and not over 500 tons	4	24	6
All steamers over 500 tons and not over 1,000 tons	6	35	8
All steamers over 1,000 tons	8	50	10

Provided, That all steamers that are constructed wholly of iron or steel plates and whose deck houses or superstructure is constructed wholly of iron or steel plates, carrying passengers, shall not be required to carry any water barrels or tanks, as required by the preceding table.

2. For freight and towing steamers:

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons	....	2	1
All steamers over 10 tons and not over 25 tons	....	4	1
All steamers over 25 tons and not over 50 tons	1	6	2
All steamers over 50 tons and not over 100 tons	1	8	2
All steamers over 100 tons and not over 200 tons	1	12	2
All steamers over 200 tons and not over 500 tons	2	15	3
All steamers over 500 tons and not over 1,000 tons	3	20	4
All steamers over 1,000 tons	4	25	5
Provided, however, That tanks of suitable dimensions and arrangements, or buckets in sufficient number, may be substituted for barrels on all vessels. Five buckets shall be considered as equivalent to one barrel.			

Provided, That all freight and towing steamers that are constructed wholly of iron or steel plates and whose deck houses are constructed of iron or steel plates shall not be required to carry any water barrels or tanks, as required by the preceding table.

3. Fire buckets, barrels, or tanks must, when practicable, be constantly filled with water and in such positions on board as shall be most convenient for extinguishment of fire.

4. All axes must be located so as to be readily found in time of need, must not be used for general purposes, and must be kept in good condition.

5. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin.

All baled cotton shall be securely bound and covered with bagging on at least three-quarters of its surface, including both ends of the bale. No bales of imported or domestic hemp shall be received on any vessel carrying passengers, unless the same are properly compressed, bound with rope, wire, or metallic bands, and covered on ends or sides, according to the several methods now practiced in foreign and domestic trade.

6. All steamers on western rivers having their boilers situated so that the sparks from the fires may be driven back among combustible materials shall have a sheet-iron fender extending forward from the fire doors not less than 2 feet, at the height of the furnace fronts, and connecting with the same.

7. The main pipes and their branches, on steamers car-

rying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same, except the cabins, shall not be less than 1½ inches in diameter, except on steamers employed on western rivers, constructed prior to June 30, 1905, which steamers may use branch pipes not less than three-fourths of an inch in diameter. Steam pipes of not less than three-fourths of an inch in diameter must be led to all lamp lockers, oil rooms, and like compartments, which lamp lockers, oil rooms, and compartments, in all classes of vessels, must be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, and handles distinctly marked to indicate the compartment or parts of the vessel to which they lead.

These valves or their handles shall be placed in the most accessible part of the main deck of the vessel and so arranged that all can be inclosed in a box or casing, the door of which shall be plainly marked with the words "Steam fire apparatus."

On all oil-tank steamers the valves, instead of being located near the hatches on the upper deck, shall be all in an accessible house in which the operator is well protected from heat and smoke: *Provided,* That on oil-tank steamers a main line of steam smothering pipe of sufficient area to supply all branch pipes leading from the same to the tanks may be run the entire length of the deck, and only the main stop valve of the main line shall be required to be housed. All branch pipes shall be provided with valves which shall be left open at all times, so

that the steam may enter all compartments simultaneously. Such branches as may not be required after the fire is definitely located may be shut off, in order that the entire system may be concentrated on one tank.

Provided, That carbonic-acid gas or other extinguishing gases or vapors may be substituted in place of steam as aforesaid and for the above-described purposes, when such gas or vapor and the apparatus for producing and distributing the same shall have been approved by the Board of Supervising Inspectors: *Provided,* That the use of such apparatus shall be allowed by law.

8. Steamers required to be provided with double-acting steam fire pumps or other equivalents for throwing water shall be equipped with such pumps according to their tonnage, as follows:

Steamers over 20 tons and not exceeding 150 gross tons shall have not less than 50 cubic inches pump-cylinder capacity. Steamers of over 150 gross ton and under 3,000 tons shall have not less than one-third of 1 cubic inch pump-cylinder capacity for every gross ton. Steamers of 3,000 gross tons and over shall have pump cylinder of not less than 1,000 cubic inches capacity. This rule shall apply only to pumps installed after June 30, 1907, and all pumps now approved and in use or installed before said date shall be accepted if complying with the requirements of law and regulations in force at the time of the adoption of this rule.

Upon such steamers fire mains shall be led from the pumps to all decks, with sufficient number of outlets arranged so that any part of the steamer can be reached

with water with the full capacity of the pumps and by means of a single 50-foot length of hose from at least one of said outlets. On all classes of steamers every such pump shall be fitted with a gauge and a relief valve adjusted to lift 100 pounds pressure.

9. Steamers are not restricted to any particular proportions for fire pumps. Any dimensions that will attain the requirements specified in section 8, or greater in capacity, may be allowed: *Provided, however,* That all hydrant connections be supplied with suitable spanners.

10. The capacity of the pipes and hose leading from the pumps must in no case be less than that of the discharge opening of the pump: *Provided, however,* That the pipe and hose shall in no instance be less than 1½ inches in internal diameter.

And provided further, That steamers of 15 tons and under may be allowed to use hose of three-fourths of an inch internal diameter, but in no case shall it be less than the discharge opening of the pumps, it being further provided that open boats of less than 10 gross tons that are fully equipped with buckets, as required by these rules and regulations, shall not be required to carry hose.

11. A rotary pump, when driven by an engine independent of the main engine, may be considered as an equivalent for the double-acting fire pump, and used as such when equal to it in efficiency and capacity.

12. Any steamer having on board an independent steam pump and an auxiliary boiler suitably arranged and of sufficient strength and capacity for testing the boilers thereof; or if one of the hand fire pumps be suitably

arranged and of sufficient strength and capacity for testing the boilers; or if the "doctor," so called, when arranged permanently for testing the boilers, is, in the judgment of the inspectors, suitable for the purposes intended, may be considered as having complied with the law requiring a pump for testing boilers.

13. Any steamer of 50 gross tons or under, required to have a double-acting steam fire pump, and having in use on board a "doctor," so called, may be considered as having a lawful equivalent for such a pump when such "doctor" has pipes attached to it leading to the upper and between decks, such pipes being provided with hose and valves, according to law; but the pipes and hose shall in no case be less than 1½ inches in internal diameter. The pumps for supplying the boilers shall in no case be considered as an equivalent for the double-acting steam fire pump on steamers above 50 gross tons. Every steamer exceeding 150 gross tons and not otherwise provided for shall be provided with one good double-acting fire pump to be worked by hand: *Provided,* That when a steam pump is equipped to work by hand the same shall be accepted as a hand fire pump. Each chamber shall be of sufficient capacity, and the stroke so regulated, that not less than 100 cubic inches of water shall be displaced by each stroke of the piston. Two smaller pumps may be allowed to take the place of the one pump of 100 cubic inches capacity provided for in this section when their combined capacity equals or exceeds 100 cubic inches. Each pump shall be placed in the most suitable part of the vessel for efficient service, having suitable, well-fitted

hose to such pump long enough to reach to all parts of the vessel, kept at all times in perfect order, with brakes shipped up and hose coupled on ready for immediate use: *Provided,* That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading.

All steamers of more than 20 tons, carrying passengers, including pleasure vessels, shall be provided with such number of good and efficient portable fire extinguishers, approved by the Board of Supervising Inspectors, as shall hereafter be prescribed, viz.:

	Fire extinguishers
Steamers of over 20 and not over 50 gross tons	1
Steamers of over 50 and not over 100 gross tons	2
Steamers of over 100 and not over 500 gross tons	3
Steamers of over 500 and not over 1,000 gross tons	6
Steamers of over 1,000 gross tons, not less than	8

Freight and towing steamers of over 250 tons shall be provided with chemical fire extinguishers as hereafter prescribed, viz.:

	Fire extinguishers
Steamers of over 250 and not over 500 gross tons	1
Steamers of over 500 gross tons	2

The tables of required fire extinguishers in this section are based on the capacity of the ordinary machine, which is about 2½ gallons. Fire extinguishers of approved types of less capacity are allowable when their total contents equal the required quantity.

All chemical fire extinguishers thus provided for shall be able to withstand a pressure of 350 pounds to the

square inch, except such fire extinguishers as have no stopcock or valve between the chamber and discharge, in which case they may be used after having been tested to 150 pounds pressure to the square inch.

Fire extinguishers shall be located in such parts of the vessels as in the judgment of the local inspectors will be most convenient and serviceable in case of emergency, and so arranged that they may be easily removed from their fastenings. Every fire extinguisher thus provided for shall be discharged and examined at each annual inspection. Portable hand pumps with an attached carrying capacity of 5 gallons of water may be substituted for the fire extinguishers above described.

14. All steam fire pumps required shall be supplied with connecting pipes leading to the hold of the vessel with stopcocks or shut-off valves attached and so arranged that such pumps may be used for pumping and discharging water overboard from the hold.

Each and every steam vessel shall be fitted with a bilge pipe leading from each compartment of the vessel and connecting with a suitably marked valve to the main bilge pump in the engine room, and each compartment of all steam vessels shall be fitted with suitable sounding pipe, the opening of which shall be accessible at all times, except that in compartments accessible at all times for examination no sounding tubes are necessary.

Steam siphons may be substituted in each compartment for the bilge pipes.

All hose required on steam vessels for fire purposes shall be tested to a pressure of 100 pounds to the square

inch at each inspection, and it shall be the duty of the local inspectors at each annual inspection to see that the couplings are securely fastened to the hose by suitable external or internal clamps, and at least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle: *Provided,* That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading.

15. All pipes used as mains for conducting water from fire pumps on board steam vessels in place of hose shall be of wrought iron, brass or copper, with wrought-iron, brass or composition hose connections.

16. Wherever the words "passenger steamer," "steamer carrying passengers," or "vessel carrying passengers" occur in this entire rule (Rule IV), the said words shall be construed to mean and apply to only vessels carrying passengers for hire, and the words "carrying passengers" shall be construed to mean "carrying passengers for hire."

RULE V.—LICENSES, HOW OBTAINED, AND PENALTIES RELATING THERETO.

1. Before an original license is issued to any person to act as a master, mate, pilot, or engineer he must personally appear before some local board or a supervising inspector for examination; but upon the renewal of such license, when the distance from any local board or supervising inspector is such as to put the person holding the

same to great inconvenience and expense to appear in person, he may, upon taking oath of office before any person authorized to administer oaths, and forwarding the same together with the license to be renewed, to the local board or supervising inspector of the district in which he resides or is employed, have the same renewed by the said inspectors, if no valid reason to the contrary be known to them; and they shall attach such oath to the stub end of the license which is to be retained on file in their office: *Provided, however,* That any officer holding a license, and who is engaged in a service which necessitates his continuous absence from the United States, may make application in writing for one renewal and transmit the same to the board of local inspectors with a statement of the applicant, verified before a consul or other officer of the United States authorized to administer an oath, setting forth the reasons for not appearing in person, and upon receiving the same the board of local inspectors that originally issued such license shall renew the same for one additional term of such license, and shall notify the applicant of such renewal.

The first license issued to any person by a United States inspector shall be considered an original license, where the United States records show no previous issue to such applicant.

No original license shall be issued to any naturalized citizen on less experience in any grade than would have been required of an American by birth.

2. All licenses hereafter issued to masters, mates, pilots, and engineers shall be filled out on the face with pen and

black ink instead of typewritten. Inspectors are directed, when licenses are completed, to draw a broad pen and black-ink mark through all unused spaces in the body thereof, so as to prevent, as far as possible, illegal interpolation after issue.

3. Licensed officers serving under five years' license, entitled by license and service to raise of grade, shall have issued to them new licenses for the grade for which they are qualified, the local inspectors to forward to the Supervising Inspector-General the old license when surrendered with the report of the circumstances of the case.

But the grade of no license shall be raised, except as hereinafter provided, unless the applicant can show one year's actual experience in the capacity for which he has been licensed: *Provided, however,* That one year's experience as quartermaster, wheelsman, or watchman while holding a second-class pilot license, shall entitle the holder of such license to examination for raise of grade.

4. In case of loss of license, of any class, from any cause, the inspectors, upon receiving satisfactory evidence of such loss, shall issue a certificate to the owner thereof, which shall have the authority of the lost license for the unexpired term, unless in the meantime the holder thereof shall have the grade of his license raised after due examination, in which case a license in due form for such grade may be issued.

5. Inspectors shall, before granting an original license to any person to act as an officer of a vessel, require the applicant to make his written application upon the blank form authorized by the Board of Supervising Inspectors,

which application shall be filed in the records of the inspector's office. Inspectors shall also, when practicable, require applicants for pilot's license to have the written indorsement of the master and engineer of the vessel upon which he has served, and of one licensed pilot, as to his qualifications. In the case of applicants for original engineer's license, they shall also, when practicable, have the indorsement of the master and engineer of a vessel on which they have served, together with one other licensed engineer.

6. No original master's, mate's, pilot's, or engineer's license shall be issued hereafter or grade increased except upon written examination, which written examination shall be placed on file as records of the office of the inspectors issuing said license; and, before granting or renewing a license, inspectors shall satisfy themselves that the applicants can properly hear the bell and whistle signals.

7. Any applicant for license who has been duly examined and refused may come before any local board for reexamination after one year has expired.

8. When any person makes application for license it shall be the duty of the local inspectors to give the applicant the required examination as soon as practicable.

9. Any person who has served at least one year as master, commander, pilot, or engineer of any steam vessel of the United States in any service in which a license as master, mate, pilot, or engineer was not required at the time of such service, shall be entitled to license as master, mate, pilot, or engineer, if the inspectors, upon written

examination, as required for applicants for original license, may find him qualified: *Provided,* That the experience of any such applicant within three years of making application has been such as to qualify him to serve in the capacity for which he makes application to be licensed.

Officers of the Naval Militia who are applicants for license as master or pilot of steam vessels of the Naval Militia, after passing an examination for color blindness, may be examined by the inspectors as to their knowledge of the pilot rules and handling of vessels; and if the applicant be found qualified, in the judgment of the inspectors, he may be granted a special license as master, mate, or pilot on such vessels on the waters of the district in which such license is granted, and for no other purpose.

Any officer of the Naval Militia who is an applicant for license as chief engineer or assistant engineer of steam vessels of the Naval Militia may be examined by inspectors and granted a special license as such, and for no other purpose, if, in the judgment of the inspectors, he is qualified. And the inspectors shall state on the license the name of the vessel on which such master, mate, pilot, or engineer is authorized to act in the capacity for which he is licensed.

All licenses issued to officers of the Naval Militia provided for in the preceding paragraph of this section shall be surrendered upon the party holding it becoming disconnected from the Naval Militia by resignation or dismissal from such service; and no license shall be issued as above except upon the official recommendation of the

chief officer in command of the Naval Militia station of the State in which the applicant is serving.

Masters, mates, engineers, and assistant engineers now serving as such on tenders and light-vessels under the jurisdiction of the Light-House Establishment may be granted special licenses for the Light-House Service upon satisfactory evidence of their fitness for such special license. Experience in the Light-House Service shall be sufficient to entitle applicants to this examination, and no other experience shall be required for such special license.

10. No person holding special license (Form 878) shall be eligible for examination for a higher grade of license until such person has actually served two full seasons under the authority of his license and one additional full season in a subordinate capacity upon steamers requiring regularly licensed officers.

11. Whenever an officer shall apply for a renewal of his license for the same grade the presentation of the old certificate shall be considered sufficient evidence of his title to renewal, which certificate shall be retained by the inspectors upon their official files as the evidence upon which the license was renewed: *Provided,* That it is presented within twelve months after the date of its expiration, unless such title has been forfeited or facts shall have come to the knowledge of the inspectors which would render a renewal improper; nor shall any license be renewed in advance of the date of the expiration thereof, unless there are extraordinary circumstances that shall justify a renewal beforehand, in which case the rea-

sons therefor must appear in detail upon the records of the inspectors renewing the license.

12. When the license of any master, mate, pilot, or engineer is revoked such license expires with such revocation, and any license subsequently granted to such person shall be considered in the light of an original license. And upon the revocation or suspension of the license of any such officer said license shall be surrendered to the local inspectors ordering such suspension or revocation.

13. The suspension or revocation of a joint license shall debar the person holding the same from the exercise of any of the privileges therein granted, so long as such suspension or revocation shall remain in force.

14. When the license of any master, mate, engineer, or pilot is suspended, the inspectors making such suspension shall determine the term of its duration, except that such suspension shall not extend beyond the time for which the license was issued.

15. It shall be the duty of all inspectors, before renewing an existing license to a master or pilot of steam vessels for any waters who has not been employed as master or pilot of steam vessels on such waters during the three years preceding the application for renewal, to satisfy themselves, by an examination in writing, or orally, to be taken down in writing by the inspectors, that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed.

16. Each master and pilot of steam vessels, wherever employed, shall, when receiving his license, either original or renewal, be furnished with a pamphlet copy of the

rules and regulations governing pilots and of the statutes upon which such rules are founded, applicable to the waters on which their licenses are intended to be used, as stated in the body thereof.

17. Inspectors are forbidden to issue original licenses to pilots who can not read and write: *Provided, however,* That upon navigable waters of the United States newly opened to steamboat navigation, and where the only pilots obtainable are illiterate Indians or other natives, the fact that such persons can neither read nor write shall not be considered a bar to such Indians or other natives receiving license as pilot of steam vessels, provided they are otherwise qualified therefor. Inspectors having jurisdiction over the Red River of the North and rivers whose waters flow into the Gulf of Mexico are forbidden to issue original licenses to pilots for routes extending beyond these rivers.

18. Local inspectors having jurisdiction on the Atlantic coast, Pacific coast, or Gulf of Mexico may indorse any pilot's license for extension of route, subject to the approval of the adjoining boards having jurisdiction.

19. Masters and pilots of steamers carrying passengers for hire shall exclude from the pilot houses and navigator's bridge of such steamers, while under way, all persons not connected with the navigation of such steamers, except officers of the Steamboat-Inspection Service and of the Revenue-Cutter Service when upon business: *Provided,* That licensed officers of steamboats, persons regularly engaged in learning the profession of pilot, officers of the United States Navy, United States Coast

and Geodetic Survey, and Light-House Service, and engineer officers connected with the improvement of rivers and harbors may be allowed in the pilot house or upon the navigator's bridge upon the responsibility of the officer in charge.

The master of every such steamer shall keep three printed copies of this section of Rule V posted in conspicuous places on such steamer, one of which shall be kept posted in the pilot house.

Such printed copies shall be furnished by the Department of Commerce and Labor to local inspectors for distribution.

23. Whenever a steamer meets with an accident involving loss of life or damage to property, it shall be the duty of the licensed officers of such steamer to report the same in writing and in person without delay to the local board nearest the port of first arrival. If the accident happens upon the high seas or without the jurisdiction of inland waters, the board to whom the report is first made shall make the investigation, but if the accident occurs within the jurisdiction of inland waters, the report shall be transmitted to the board within whose jurisdiction the accident occurred, which board shall make the investigation: *Provided,* That when from distance it may be inconvenient to report in person it may be done in writing only, and the report sworn to before any person authorized to administer oaths.

25. No person shall receive an original license as engineer of vessels of above 15 gross tons, propelled by gas, fluid, naphtha, or electric motors, carrying freight or

passengers for hire, who has not served at least one year on motor boats, or in the engineer's department of steam vessels, or who has not had at least two years' experience in the construction of marine motor engines and their installation. All examinations for license as engineer of motor vessels shall be reduced to writing and filed with the application of the candidate.

Masters of Steam Vessels.

There shall be a duly licensed master on board every steam vessel of more than 100 gross tons whenever such steamer is underway.

No original license as master of any steam vessel shall be issued, except under the conditions hereinafter provided:

Masters of Ocean Steam Vessels.

26. Any applicant for license as master of ocean steamers must furnish satisfactory documentary evidence to the local inspectors that he has had three years' experience on ocean steamers, one year of which has been as chief mate, or five years' experience on ocean sail vessels of 300 gross tons and upward, two years of which must have been as a licensed master of sail vessels; and he must understand navigation and be able to determine the ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by the altitude of either the sun, moon, or stars. The examination to determine his qualifications shall be in writing, which shall be kept on file in the office of the inspectors granting the license.

It is further provided, That where any person has actually served as a licensed third officer of ocean steamers of 3,500 gross tons and upward for five years, he shall be eligible for examination for license as master of ocean steamers.

Any person who has had three years' actual experience as master of steam vessels of 1,000 gross tons and upward on the Great Lakes and can produce documentary evidence of the fact may be examined for license as chief mate of ocean steamers, and after having had one year's actual experience as chief mate of ocean steamers of 1,000 gross tons and upward may be examined for license as master of ocean steamers, the examination to be the same as that provided for in the first paragraph of this section.

Masters of Lake, Bay, Sound, and Ferry Steamers.

27. No original license as master of lake, bay, and sound steamers shall be issued hereafter to any person who has not been licensed and served at least one year as first-class pilot or chief mate on such steamers, such service as pilot or chief mate to have been within the three years next preceding the application for license.

Provided, however, That any person who has served three years as master of sail vessels on the Great Lakes shall be eligible for examination for master's license of steam vessels on the Great Lakes and other inland waters.

It is further provided, That masters of barge consorts on the Great Lakes having had three years' actual experience as such, who have been licensed as first-class pilots

for one year or more, may be examined and licensed as masters of steam vessels on the Great Lakes and other inland waters, if found qualified.

Provided further, That any person holding a first-class pilot's license and having had one year's experience as licensed first-class pilot may be eligible for examination as master of ferry steamers.

Provided further, That any person who has operated under the authority of a second-class pilot's license for two years may be examined for license as master of lake, bay, sound, and ferry steamers, and, if found qualified, may receive a master's license for such steamers as in the judgment of the inspectors the applicant is qualified to command: *Provided,* That a part of the required experience must have been within the three years next preceding the application.

Whenever a master or mate desires to act in the double capacity of master and pilot, or mate and pilot, and furnishes the necessary evidence of his qualifications, the local inspectors shall indorse such pilot routes on the certificate of license.

Masters of Coastwise Steamers.

28. Any person holding a license as master of lake, bay, and sound steamers may have indorsed thereon the authority allowing him to act as master of steamers upon the waters of the Atlantic coast and the Gulf of Mexico: *Provided,* That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic coast or the

Gulf of Mexico, which experience must have been obtained within the three years next preceding his application for such indorsement, and the fact must be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating such steamers. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as master. Practical service in the deck department of an ocean-going or coastwise steam yacht shall be accepted, when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels, as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel.

Masters of River Steamers.

29. Inspectors shall examine all applicants for original license as master of steamers navigating rivers exclusively, which examination shall be reduced to writing and made a part of the permanent records of the office of the inspectors making such examination; and no original license shall be issued to any person to act as master of such steamers who has not, by actual service on board of such steamers for a period of not less than three years, acquired practical knowledge, skill, and experience essential in case of emergency and disaster, and in the navigation of such steamers with safety to life and property,

and at least one year of service to have been within the three years next preceding the application, and such license shall entitle the holder of the same to act as master on any river steamer of the United States, and no license as master shall be issued to any applicant who can not read and write, and who has not served at least one year as licensed mate or pilot of steam vessels.

The line of examination to be pursued by inspectors in examining applicants for original license as master of river steamers shall be as follows:

(1) As to his general knowledge of the duties of master of such steamers.

(2) As to his ability to handle the wheel in case of emergency or disaster.

(3) As to the knowledge of his duties and proper method of procedure in case of fire on his vessel.

(4) As to his knowledge of proper management of vessel and crew in case of collision and sinking.

(5) As to executive ability generally to manage officers and crew.

(6) As to his general knowledge and ability to navigate steamers with safety to life and property.

(7) As to his knowledge of pilot rules governing the navigation of such steamers.

(8) As to his knowledge of signals between the pilot house and engine room.

(9) As to his knowledge of signal lights and their proper position on all steam and other vessels.

(10) As to duties of master in case of fog or stormy weather, and on such other subjects in connection with

the navigation of such vessels as the inspectors conducting such examination may deem proper and necessary.

Masters of Sail Vessels.

Local inspectors may, upon due application and examination, license any person as master of sail vessels of 700 gross tons and upward, or of sail vessels of any tonnage carrying passengers for hire, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as master of sail vessels of 200 gross tons and upward or as licensed chief mate of sail vessels of 700 gross tons and upward for the full period of twelve months next preceding the application.

Mates of Sail Vessels.

Local inspectors may, upon due application and examination, license any person as chief mate of sail vessels of 700 gross tons and upward, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as chief mate of sailing vessels of 200 gross tons for one year, or as second mate on vessels of 200 gross tons for a period of two years next preceding the application.

The examination for license as master or mate of sail vessels of 700 gross tons and upward shall be the same as required for masters and mates of steam vessels.

30. Whenever the owner of steam or sailing yachts who has had three years' experience on board such yachts applies for license to act as pilot or master of lake, bay,

sound, or river steam yachts, the local inspectors shall give the applicant a written examination in regard to his knowledge in handling such vessels, and his familiarity with the lights, light-houses, channels, buoys, obstructions, courses and distances between certain points in the waters for which he makes application for license, and shall also examine him as to his knowledge of the pilot rules of such waters, the running and anchor lights, fog signals, the use of the lead, signal bells between the engine room and pilot house, and the general rules and regulations for steam vessels. If the local inspectors are satisfied, after such examination, of the applicant's ability, they shall issue the applicant a license as pilot or master of steam yachts for the waters over which they are authorized to issue licenses.

Whenever the owner of a steam or sailing yacht of over 100 gross tons, who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant as to his knowledge of the rules of the road, fog signals, signal lights—inland and international; the use of the lead and line; the use of the patent and chip logs, the compass, variation and deviation of the compass, the use of the drag, the use of oil during storms, bell signals between pilot house and engine room, handling of steam vessels, laws of storms, course and distance by chart, keeping the log book, middle latitude sailing, Mercator's sailing, method of obtaining latitude and longitude by dead reckoning, latitude by altitude of either the sun,

moon, or stars; longitude by chronometer (time sights). Practical problems will be given in the subjects of latitude and longitude. The examination shall be in writing, which shall be kept on file in the office of the local inspectors. If said examination is satisfactory to the local inspectors, they shall issue to the applicant a master's license authorizing him to discharge the duties of master of steam yachts, either for coastwise or ocean navigation.

31. Any person navigating a pleasure yacht of 15 gross tons and under, for pleasure only, holding a master's or pilot's license, is fully authorized to navigate such pleasure yacht in the inland waters of the United States without being required to report to the various boards of inspectors whose district they may be passing through.

32. Any applicant for original license to act as master or mate of steam pilot boats, or of steamers navigating the waters of the whaling grounds in the Alaskan seas, or of steamers engaged exclusively in the business of whale fishing, or of steamers engaged in the Atlantic, Pacific, or Gulf coast fisheries, or of steam or sail vessels navigating between ports of the Hawaiian Islands, or between ports of the island of Porto Rico, must have had at least three years' experience in the deck department of such steamers, which fact must be verified by documentary evidence; and such applicant shall only be subjected to such examination as shall satisfy the inspectors that the applicant is capable of navigating such vessels: *It is provided,* That any person who has had at least five years' experience on sail vessels licensed in the fisheries of the United States, two years of which have been as master

or mate of such sailing vessels, may be examined for license as master or mate of steam fishing vessels to be employed exclusively in the Atlantic, Pacific, and Gulf coast fisheries. The license issued under this section shall state in the body thereof "for coastwise only," Pacific or Atlantic coast, as the case may be, and between what ports on either of said coasts.

It is further provided, That said master's or mate's license may be indorsed as pilot on such inland waters on the above-named coasts as the local inspectors at the various ports may find the holder qualified to act on as pilot, after examination by the local inspectors, such examination to be in writing and preserved in the files of the inspectors' office.

Masters of Passengers Barges.

33. Any person applying for license as master of barges carrying passengers for hire must have had three years' experience in the deck department of such vessels, and shall be subjected to such examination as will show his ability to handle the class of vessels for which he desires a license.

Chief Mate of Ocean Steamers.

34. No original license as chief mate of ocean steamers shall be issued to any person who has not served at least three years in the deck department of such steam vessels, one year of such service to have been as second mate of such vessels.

Provided, That any person who has had five years'

experience on sail vessels of 300 gross tons and over, two years of which have been in the capacity of licensed chief mate of sail vessels of 700 gross tons and over, may be licensed as chief mate of ocean steamers.

It is further provided, That any person holding a license as chief mate, who has had two years' service in the capacity of second mate, or watch officer actually in charge of a bridge watch since receiving such license as chief mate, shall be entitled to examination for master's license.

Second Mate of Ocean Steamers.

35. No original license for second mate of ocean steamers shall be issued to any person hereafter who has not had three years' experience on such steam vessels, two years of which shall have been as watch officer or quartermaster, or two of the three years' experience required may be on the school-ship *St. Marys* or some other similar vessel, as indicated by his graduating certificate, or he must have had three years' experience on ocean sail vessels of 300 gross tons and over, one year of which shall have been as second mate of such sail vessels of 700 gross tons and upward: *Provided,* That any person holding a second mate's license who has had two years' experience on the same as watch officer shall be entitled to an examination for chief mate's license.

Third Mate of Ocean Steamers.

36. No person shall receive an original license as third mate of ocean steamers who has not had three years'

experience on ocean or coastwise steam vessels or sail vessels of 300 gross tons and upward as cadet or able seaman, or two of the three years' experience required may be on the school-ship *St. Marys,* or some other similar vessel, as indicated by his graduating certificate: *Provided,* That any person holding a license as third mate who has had two years' experience on said license as quartermaster on vessels of 2,500 gross tons and over shall be entitled to examination for second mate's license.

37. No original license as chief mate of ocean steamers, as second mate of ocean steamers, or as third mate of ocean steamers shall be issued to any person who does not understand navigation and who is not able to determine a ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by altitude of either the sun, moon, or stars; said examination to be in writing and to be kept on file in the office of the local inspectors issuing the license.

Mate of Ocean and Coastwise Steamers of 500 Tons and Under.

38. Any first-class seaman who has had three years' experience on the deck of a sail vessel and one year's experience in the deck department of a steam vessel shall be eligible for an examination for license as second mate of ocean and coastwise steamers of 500 gross tons and under.

Mates of Coastwise Steamers.

39. Any person who has been licensed as second mate of ocean steamers. having had one year's experience as

such, may have his license indorsed to act as chief mate of coastwise steamers without further examination.

Any person holding a license as first-class pilot of lake, bay, or sound steamers may have his license indorsed to act as chief mate of coastwise steamers: *Provided,* That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic coast, Pacific coast, or the Gulf of Mexico, which experience must have been obtained within three years preceding his appliction for such indorsement, and this fact must be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating the steamer. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as chief mate. Any person who has had three years' experience in the deck department of a steam vessel shall be eligible for examination for license as chief mate of coastwise steamers upon the waters of the Atlantic coast, Pacific coast, and the Gulf of Mexico.

Mates of Inland or River Steamers.

40. Whenever any person presents himself for examination for license as mate of inland or river steamers the local inspectors shall examine him as to his knowledge, experience, and skill in loading cargo and in handling and stowage of freight, his knowledge of the operation and handling of fire apparatus, the launching and handling

of lifeboats, his knowledge of life-preservers and the method of adjusting them, his ability to manage the crew and direct and advise the passengers in case of emergency, and his general familiarity with his duties in maintaining discipline and protecting the passengers, and if found qualified they shall grant him a license as such, but no such license shall be granted to any person who has not had at least two years' experience in the deck department of a steam vessel.

First-Class Pilots.

41. No original license as first-class pilot shall be issued to any person hereafter who has not had three years' experience in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort: *Provided,* That on the Mississippi and tributary rivers one year of such required experience must have been in the pilot house as steersman.

Second-Class and Special Pilots.

42. No original license as second-classs pilot shall be issued to any person who has not had three years' experience in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort: *Provided,* That on the Mississippi and tributary rivers one year of such required experience must have been in the pilot house as steersman.

43. The navigation of every steamer above 100 gross tons shall be under the control of a first-class pilot, and every such pilot shall be limited in his license to the

particular service for which he is adapted. Special pilots may also be licensed for steamers of 10 gross tons and under, locally employed.

44. A first-class or second-class pilot may be allowed to take charge of a steamer not exceeding 100 gross tons. A second-class pilot may be authorized by the indorsement of the local inspectors granting the license to act in charge of a watch on any steamer.

45. All passenger and ferry steamers shall, in addition to the regular pilot on watch, have one of the crew also on watch, in or near the pilot house; and this rule applies to all steamers navigating in the nighttime.

46. No original license for pilot of any route shall be issued to any person, except for special license for steamers of 10 gross tons and under, who has not served at least three years in the deck department of a steamer, motor vessel, sail vessel, or barge consort, one year of which experience must have been obtained within the three years next preceding the date of application for license, which fact the inspectors may require, when practicable, to be verified by the certificate, in writing, of the licensed master or pilot under whom the applicant has served, such certificate to be filed with the application of the candidate.

47. Pilots of steam vessels, while in the discharge of their duties, must be governed by the rules of the Board of Supervising Inspectors, made for their guidance, and not by any instructions emanating from any inspector or other person.

48. Whenever any pilot applies to a board of local in-

spectors for an extension of his pilot's route, he shall make written application, by letter, stating the extension desired, and he shall be examined, in writing, on the aids to navigation on said extension, and, if found qualified, shall receive such extension.

49. No original license as master, mate, or pilot of any vessel propelled in whole or in part by steam, gas, fluid, naphtha, alco-vapor, electric, or other like motors, or master or mate of sail vessels, shall be granted except on the official certificate of a surgeon of the Public Health and Marine-Hospital Service that the applicant is free from the defect known as color blindness. No renewal of license shall be granted to any officer of the classes named who has not been previously examined and passed for color blindness.

Any person requiring examination for color blindness who is living at a distance of 100 miles or more from a surgeon of the Public Health and Marine-Hospital Service may be examined for color blindness by any reputable physician; and the physician shall furnish a duplicate report of the examination made upon the regulation blanks, one copy of which shall be furnished the applicant and the other sent to the local inspectors of steam vessels to whom the applicant shall apply for such original or renewal of license.

50. It shall be the duty of the officer in charge of every steamer carrying passengers to cause to be prepared a station bill for his own department, and one also for the engineer's department, in which shall be assigned a post or station of duty for every person employed on board

such steamer in case of fire or other disaster; which station bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week, to call all hands to quarters and exercise them in the discipline, and in the unlashing and swinging out of the lifeboats, weather permitting, and in the use of the fire pumps and all other apparatus for the safety of life on board of such vessel, with especial regard for the drill of the crew in the method of adjusting life-preservers and educating passengers and others in this procedure and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log book, stating the day of the month and hour when so exercised; and it shall be the duty of the inspectors to require the officers and crew of all such vessels to perform the aforesaid drills and discipline in the presence of the said inspectors at intervals sufficiently frequent to assure the said inspectors by actual observation that the foregoing requirements of this section are complied with; the master shall also report monthly to the local inspectors the day and date of such exercise and drill, the condition of the vessel and her equipment, and also the number of passengers carried, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce this rule shall be deemed cause for the suspension or revocation of the license of such officer.

The *general* fire-alarm signal shall be a continuous rapid ringing of the ship's bell for a period of not less than 20 seconds, and this signal shall not be used for any other purpose whatsoever.

Three copies of this section shall be furnished every steamer carrying passengers, to be framed under glass and posted in conspicuous places about the vessel.

51. It shall be the duty of the mate of every inland or river steamer carrying passengers to assign to deck or steerage passengers the space they may occupy on board during the voyage, and to supervise the stowage of freight or cargo, and see that the space set apart for passengers is not encroached upon. He shall also carefully examine all packages of freight delivered on board for shipment, with a view to detect and prevent any combustible or other dangerous articles prohibited by law being delivered on board. Three copies of this section shall be furnished every steamer to which this section applies, to be framed under glass and posted in conspicuous places about the steamer, one of which shall be on the main deck.

RULE VI.—INSPECTION OF STEAMERS.

1. The annual inspection of any vessel subject to the provisions of Title LII, Revised Statutes of the United States, must be made only on written application, presented to the United States local inspectors by the owner, master, or authorized agent of the vessel to be inspected. Such application must state upon its face that previous application for inspection has not been made to any other board of local inspectors or supervising inspector.

2. Steam vessels employed by the Government, unless the titles of the same are actually vested in the United States, are not exempt from inspection.

3. Inspectors may lawfully inspect within their respective districts, upon proper application, any vessel running upon the waters of their district the certificate of whch is about to expire.

4. In the inspection of the hulls of vessels, if the inspector shall not have satisfactory evidence otherwise of the soundness of the timber, he shall not give a certificate until the hull of the vessel shall be bored to his satisfaction.

5. Whenever any vessel is placed upon the dock for repairs it shall be the duty of the master, owner, or agent to report the same to the board of local inspectors of that district, so that a thorough inspection may by them be made to determine what is necessary to make such vessel seaworthy if the condition or age of the vessel, in the judgment of the inspectors, renders such examination necessary.

6. Certificates of inspection signed by one local inspector only shall not be valid, nor shall the name of a regular inspector be substituted by that of any other person upon any such certificate. This rule also applies to licenses.

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing the revocation or suspension of certificates of inspection, in case the same be allowed by law, or from preventing local inspectors from inspecting

vessels for renewal of certificate, upon due application in writing, at any time not exceeding sixty days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any vessel at an earlier period than sixty days anterior to the expiration of the vessel's certificate, when such vessel has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" (Department decision 7703, August 17, 1886, p. 216, Manual, edition 1890) for the purpose of saving traveling expenses.

Local inspectors issuing a permit to any vessel to proceed to other ports for repairs must state upon the face of the same the conditions upon which it is granted and whether the vessel is to be allowed to carry freight or passengers, the quantity and number: *Provided, however,* That no vessel whose certificate has *expired* will be permitted to carry passengers or freight while en route to another port for repairs.

When, under section 4456, Revised Statutes of the United States, vessels obtain a permit from the local inspectors of a district to go from their district to another to make repairs, said local inspectors shall notify the supervising inspector of their district, stating the repairs to be made on said vessels. The supervising inspector shall notify the supervising inspector of the district where

such repairs are to be made, furnishing him a copy of the report of the inspectors indicating the repairs ordered on said vessels.

RULE VII.—FERRYBOATS.

1. Steam vessels employed as a means of crossing any river, or other similar water, in continuation of any established highway, shall be considered ferryboats under the law, and the navigation of such vessels must be confined to the ferry routes specified in the inspection certificate issued; but such vessels may be permitted, under excursion permits, to go beyond their authorized routes with passengers only, or without such permit, to lighten or relieve vessels in distress.

2. All ferryboats of more than 75 gross tons carrying passengers for hire, whose construction is commenced after December 31, 1908, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if the largest compartment is filled with water.

3. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life rafts, outside ladders, and other means of escape, in case of disaster, as, in the opinion of the inspectors, shall meet the requirements of each particular case. But in no case shall the cubic feet of boat capacity be less than that provided in the following table:

	Cubic feet
Ferryboats of 50 and not over 300 gross tons..........	120
Ferryboats over 300 and not over 600 gross tons......	240
Ferryboats over 600 gross tons........................	360

Provided, That on ferryboats of more than 300 gross

tons, one-half the boat capacity required may be substituted by its equivalent in approved life rafts.

Ferryboats of less than 50 gross tons shall be equipped with boats or rafts as in the opinion of the inspectors may be necessary in case of disaster to secure the safety of all persons on board.

4. All ferryboats shall be equipped with a life-preserver (or float where the same is allowed by law) for every 7 square feet of passenger deck surface on single-deck ferryboats and for every 12 square feet of such deck surface on ferryboats having more than one passenger deck, and such life-preservers or floats shall be distributed in the most accessible places, where they can be reached at all times, and it shall be the duty of the local inspectors to see that all the life-preservers or floats are marked with the name of the vessel having the same on board.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage.

5. All barges in tow of steamers used for transferring persons on any lake, bay, sound, or river shall be provided with the same life-saving appliances as required for passenger steamers.

All towed barges used for transferring railroad passenger cars on any lake, bay, sound, or river, with passengers in cars, shall be required to have the same life-saving appliances as required by section 17 of Rule III.

All car ferry steamers engaged in transferring passenger cars, with passengers in cars, shall be equipped as ferryboats, excepting that the number of life-preservers

required shall equal the number of persons carried: *Provided,* That where wooden life floats are allowed by law they may be used instead of life-preservers.

It shall be the duty of the master of any such barge or steamer to see that all of the doors of the cars are unlocked and vestibules of the cars are open while the same are on the barge or steamer to allow the persons so carried free egress at all times.

RULE VIII.—EXCURSION STEAMERS AND BARGES.

1. If the master, agent, or owner of any passenger or ferry steamer desires a permit to engage in excursions, the inspectors, upon the written application of such master, agent, or owner, which application must be accompanied by an affidavit that the proper equipment is on board, may issue the same, stating the number of extra passengers the boat may carry with safety, the route she may run, and the kind and extra number of life-saving appliances with which she is provided. The permit, when used, must be framed under glass and exposed to the view of the passengers, in connection with the certificate of inspection.

2. Passenger steamers making excursions on the Northern and Northwestern lakes, bays, or rivers, or on waters of the Atlantic and Pacific coasts and rivers flowing into the same, and rivers whose waters flow into the Gulf of Mexico, shall have, in addition to their regular life-saving equipments, a life-preserver (or float where the same is allowed by law), made in accordance with the rules of the Board, or their equivalent in other approved

life-saving appliances, for each additional passenger allowed.

3. Steamers making excursions under a permit must have at least one lifeboat or life raft, in addition to the equipment required by the tables, so carried as to best secure the safety of those on board in case of disaster.

All barges carrying excursions under permit and in tow shall be required to carry a master, and shall also carry not less than two competent men in deck crew for each 500 persons or fraction thereof carried on the barge.

4. Every barge carrying passengers in tow and engaged in excursions shall be supplied with one life-preserver or one float for each passenger carried, and must have ten buckets, three axes, and two yawl boats of not less than 100 cubic feet capacity each, one of which boats must be manned and towed in such manner as to best afford prompt relief and assistance in case of accident or disaster.

Steamers or barges carrying passengers on excursions must have their extra life-saving appliances and equipments plainly marked with the vessel's name, and must have the life-preservers and floats so distributed before leaving the wharf or dock as to be at all times within easy reach of the persons carried.

It shall be the duty of the master of each sail vessel or towed barge of over 100 tons carrying passengers for hire to expose under glass two copies of the certificate of inspection in conspicuous places in the vessel where they will be most likely to be observed by passengers and others.

5. When any ferryboat leaves her ferry route to engage in excursions she shall be required to carry the same officers, crew, and equipment as required by other excursion steamers.

RULE IX.—DUTIES OF INSPECTORS.

6. Local inspectors, at their annual inspections of steam boilers, shall remove from the surface of such boilers as are covered so much of said covering as may be necessary to enable them to examine parts of the boilers which can not be properly examined from the inside, and shall examine in a thorough and careful manner, when practicable, either externally or internally, all parts of the shell of every boiler; and the masters, engineers, and owners of every steam vessel shall afford every facility necessary to carry out in the most effective and efficient manner the provisions of this section, and in no case shall an intermediate inspection be deemed any part of the regular annual inspection.

The local inspectors shall, when issuing a certificate of inspection, specify therein or thereon the number, class, or kind of licensed officers and crew required to navigate the vessel with safety at all times, but should the master or owner desire to operate the vessel not more than thirteen hours out of the twenty-four in any one day, the local inspectors shall endorse on the certificate of inspection the number and class or kind of licensed officers and crew that are necessary for such reduced period of navigation.

8. It shall also be the duty of the inspectors to compel

all floating structures, such as steam elevators (propelled by their own motive power), to have their whistles located on the front side of such superstructures having an elevation higher than the pilot house of the vessels.

9. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of same below its top, when not hinged for passing under bridges, except upon steamers navigating the Red River of the North, and rivers whose waters flow into the Gulf of Mexico, and steamers of less than 100 gross tons, whose steam whistles shall be placed not less than 2 feet above the tops of their pilot houses, and all double-end ferry steamers, and steamers similarly constructed, shall have a steam whistle both fore and aft of the smoke pipe, so that the steam, when whistle is blown, can be seen from either end of steamer; and it shall be the duty of inspectors to enforce this rule at the annual inspection.

10. It shall be the duty of both the hull and boiler inspectors to be present when the boiler is being tested by hydrostatic pressure, and the hull inspector, as well as the boiler inspector, shall observe and note the indication upon the gauge.

It shall also be the duty of both the hull and boiler inspectors to examine all pumps, hose, and other fire apparatus and to see the hose is subjected to a pressure of 100 pounds to the square inch and that the hose couplings are securely fastened in accordance with these rules.

It shall be the duty of all local inspectors to require all ocean steamers of 500 gross tons and upward to be

equipped with an efficient deep-sea sounding apparatus, in addition to the ordinary deep-sea hand lead.

14. When it is known or comes to the knowledge of the local inspectors that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the United States district attorney for prosecution under section 4437, Revised Statutes of the United States, shall require the owner or owners of said steamer to place on the boiler of said steamer a lockup safety valve that will prevent the carrying of an excess of steam and shall be under the control of said local inspectors.

On the placing of a lockup safety valve upon any boiler, it shall be the duty of the engineer in charge of same to blow or cause the said valve to blow off steam at least once in each watch of six hours or less, to determine whether the valve is in working order, and it shall be the duty of the master of such vessel to see that this rule is observed, and it shall be the duty of the master and engineer to report to the local inspectors any failure of such valve to operate.

In case no such report is made, and a safety valve is found that has been tampered with or out of order, the license of the engineer having such boiler in charge and the license of the master of such vessel shall be suspended or revoked.

It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the Department.

15. All official records and official documents on file in the office of any supervising inspector or board of local inspectors, after official action thereon has been concluded, may be open to public inspection and examination: *Provided,* That such inspection or examination be made in the office to which such official records and documents belong.

RULE X.—MISCELLANEOUS.

1. Steamers using the gong signals between the pilot house and engine room shall have a tube, of proper size, so arranged as to return the sound of the gong to the pilot house, and must also be provided with a speaking tube or other device for the purpose of conversation between pilot house and engine room.

Nothing in the above shall be construed to prevent the use of the so-called telegraph now in use for conveying signals from the pilot house to the engine room, but in all cases where the telegraph is used the signal shall be repeated back.

On steamers where the distance is more than 150 feet between deck houses, a wire cable shall be stretched between the deck houses at all times when the vessel is loaded and being navigated, this cable to be not less than 5 feet from the deck; and there shall be attached at all times to the cable a traveler with a line of sufficient continuous length to insure its operation, in order that communication between both ends of the vessel may be facilitated at all times. Failure to have such cable stretched and traveler attached at all times when the vessel is

loaded and being navigated shall be sufficient cause for the suspension of the license of the master or officer in charge.

On all steamers where the distance is more than 150 feet between perpendiculars of pilot house and forward part of the engine room, there shall be communication by means of a telephone between the pilot house and engine room, such telephone to be installed in lieu of a speaking tube.

2. Motor vessels of any tonnage other than steam vessels shall be provided with a whistle to be blown by compressed air or other power, to give the necessary whistle signals to passing vessels.

Load Line of Seagoing Steam Vessels.

3. Local inspectors shall limit the draft of water on all inspected seagoing vessels, and note the same on the face of the certificate of inspection.

The owner, agent, or master of every inspected seagoing vessel shall indicate the draft of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit, as indicated, shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate.

The master of every seagoing vessel shall, whenever leaving port, enter the maximum draft of his vessel in the log, and the master shall be held responsible that the authorized draft is not exceeded.

4. None of the inflammable articles specified in section

4472, Revised Statutes, or oil that will not stand a fire test of 300° F. shall be used as stores on any pleasure steamer or steamer carrying passengers, except that vessels not carrying passengers for hire may transport gasoline or any of the products of petroleum for use as a source of motive power for the motor boats or launches of such vessels.

5. Refined petroleum which will not ignite at a temperature of less than 110° F. may, upon routes where there is no other practicable mode of transporting it, be carried on passenger steamers; but it shall not be lawful to receive on board or transport any petroleum unless the owner or master of the steamer shall have first received from the inspectors a permit designating the place or places on such steamer in which the same may be carried or stowed, with the further condition that the permit shall be conspicuously posted on the steamer.

6. Refined petroleum must not in any case be received on board or carried unless it is put up in good iron-bound casks or barrels or in good metallic cans or vessels, carefully packed in boxes, and the casks, barrels, or boxes plainly marked on the heads thereof with the shipper's name, the name of the article, and the degree of temperature (Fahrenheit) at which the petroleum will ignite.

7. All steamers navigating the ocean during the nighttime shall have a lookout at or near the bow and one watchman in each cabin and steerage.

8. All passenger steamers navigating rivers, lakes, bays, and sounds in the nighttime shall have a watchman on each deck below the hurricane deck, including the

cabins, such as are accessible to the passengers and crew when under way; and a lookout at the bow, excepting on steamboats navigating the waters emptying into the Gulf of Mexico, having hurricane decks that terminate abaft the stem. Then the lookout shall be stationed on the forward part of such hurricane deck, who shall perform no other duty between sunset and sunrise.

9. STARTING, STOPPING, AND BACKING SIGNALS FOR STEAM VESSELS NAVIGATING THE WATERS OF THE EIGHTH AND NINTH SUPERVISING INSPECTION DISTRICTS, AND SO MUCH OF LAKE SUPERIOR AS IS INCLUDED IN THE FIFTH DISTRICT.

The eighth district embraces all the waters of the lakes north and west of Lake Erie, with their tributaries, except the portion of Lake Superior which is bounded by the states of Minnesota and Wisconsin, and also includes the upper portion of the Illinois River down to and including Peoria, Ill.

The ninth district embraces all the waters of Lakes Erie, Ontario, Champlain, Memphremagog, and the river St. Lawrence, and their tributaries.

There shall be used between the master or pilot and engineer the following code of signals, to be made by bell or whistle, namely:

1 whistle or 1 bell........................Go ahead.
1 whistle or 1 bell........................Stop.
2 whistles or 2 bells......................Back.
3 whistles or 3 bells......................Check.
4 whistles or 4 bells......................Strong.
4 whistles or 4 bells......................All right.

Two whistles or two bells shall always mean back, irrespective of other signals previously given.

The signals between the pilot house and engine room on Alaskan rivers shall be as follows:

When at rest, 1 jingle...............Stand by.
1 stroke of gong.....................Ahead full speed.
2 strokes of gong....................Astern full speed.
1 stroke of gong.....................Stop when going ahead or astern.
1 stroke of gong and 1 jingle..........Ahead half speed.
2 strokes of gong and 1 jingle..........Astern half speed
When going astern or ahead half speed,
1 jingle.............................Full speed.
When going astern or ahead full speed,
1 jingle.............................Half speed.
When going ahead or astern, any speed,
2 jingles............................Very slow.

10. Any master or pilot of any steam vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked.

11. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside, and constructed of bronze or brass or other material equal thereto in tone and volume of sound.

12. Unnecessary sounding of the steam whistle is prohibited within any harbor limits of the United States.

Whenever any licensed officer in charge of any steamer authorizes or permits such unnecessary whistling, upon conviction thereof before any board of inspectors having jurisdiction such officer shall be suspended from acting under his license as the inspectors trying the case may deem proper.

RULES OF PRACTICE FOR THE GOVERNMENT OF SUPERVISING AND LOCAL INSPECTORS OF STEAM VESSELS IN TRIALS OF LICENSED OFFICERS OF VESSELS.

I. APPLICATION AND ISSUE OF LICENSES.

1. Application for original license shall be made on the prescribed forms, and comply with the requirements of law.

2. Inspectors will furnish applicants with a written or printed notice of the time and place of examination.

3. If the inspectors shall decline to grant the applicant the license asked for they shall furnish him a statement, in writing, setting forth the cause of their refusal to grant the same.

II. SUSPENSION AND REVOCATION OF LICENSES.

1. The inspectors shall, when charges have been duly filed against a licensed officer of vessel, furnish the accused with a copy thereof, setting forth specifically their character and the section of the statutes or the rules of the board that have been violated.

2. Subpœnas shall be in the prescribed form, one copy of which shall be furnished each witness.

3. All testimony shall be reduced to writing. The accused shall be permitted to cross-examine witnesses, and in case of exceptions to questions for any cause the inspectors shall note the exceptions in the margin of the deposition. The deposition shall be signed by the witness and sworn to before an officer authorized to administer oaths.

4. The accused may have the hearing of the case continued upon the presentation of reasons satisfactory to the board, and the board may, in like manner, continue the hearing from day to day.

5. During the trial the witnesses shall be examined separately, but if the accused is also a witness he shall not be subject to this rule.

6. At any time before the conclusion of the evidence the charge or charges, if being tried on charges, may be amended, notice of said amendment being furnished to the accused of the nature of such amendment, but no amendment shall be permitted after the conclusion of the evidence.

7. Where the witnesses reside in a district other than that in which the accused is being tried, a certified copy of the charges, together with such interrogatories as the inspectors desire to propound, may be forwarded to the inspectors of the district where the witnesses reside, and said inspectors shall examine the witnesses in the same manner as prescribed in section 3 of this rule.

8. The testimony thus taken shall be forwarded to the inspectors investigating the case and read as evidence in

the cause, the same as though such testimony had been taken by the inspectors trying the same.

9. The inspectors will furnish the accused with a statement in writing of their finding in the premises.

10. The inspectors shall record in a well-bound book, to be furnished by the Department for that purpose, the charge or charges against the accused, the testimony of all witnesses and their decision in the premises, which record shall be verified by their signatures.

III. APPEAL TO SUPERVISING INSPECTORS.

1. The supervising inspector, upon notice of an appeal from the decision of the local board, provided said notice of appeal shall be made within thirty days from the date of the decision of the local board, shall give notice in writing to said local board to forward a certified copy of their decision, together with the charges and all evidence in writing on file in their office.

2. The supervising inspector shall then proceed to investigate the case under the same rules prescribed for the trial of the accused by the local board.

3. The testimony taken before the local board may be considered by the supervising inspector for the purpose of determining whether the finding of the local board is justified by the evidence, and he shall have power to remand the same for explanation or correction.

4. Upon the conclusion of the case the supervising inspector shall furnish the appellant with a notice of his finding in like manner as prescribed for local inspectors.

REVISED INTERNATIONAL RULES TO PREVENT COLLISIONS AT SEA.

The following New Rules for the Navigation of the High Seas, the outcome of the International Marine Conference, held in Washington, D. C., during the winter of 1889-90, were approved by Congress, and signed by the President, August 19, 1890. The act will take effect on July 1, 1897.

ACT OF AUGUST 19, 1890, TO ADOPT REGULATIONS FOR PREVENTING COLLISIONS AT SEA, AS AMENDED BY THE ACTS OF MAY 28, 1894, AUGUST 13, 1894, AND JUNE 10, 1896.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following regulations for preventing collisions at sea shall be followed by all public and private vessels of the United States upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

Preliminary.

In the following rules every steam vessel which is under sail and not under steam is to be considered a sailing vessel, and every vessel under steam, whether under sail or not, is to be considered a steam vessel.

The word "steam vessel" shall include any vessel propelled by machinery.

A vessel is "under way" within the meaning of these

rules when she is not at anchor, or made fast to the shore, or aground.

The word "visible" in these rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

Lights to be Exhibited from Sunset to Sunrise.

ARTICLE 1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Steamer's Masthead Light.

ART. 2. A steam vessel when under way shall carry:

(*a*) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than twenty feet, and if the breadth of the vessel exceeds twenty feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than forty feet, a bright white light, so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible at a distance of at least five miles.

Steamer's Side-Lights.

(*b*) On the starboard side a green light so constructed

as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

(*c*) On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible at a distance of at least two miles.

(*d*) The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

An Additional White Light may be Carried by Steamers When Under Way.

(*e*) A steam vessel when under way may carry an additional white light, similar in construction to the light mentioned in subdivision (*a*). These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Steamer's Towing Lights.

ART. 3. A steam vessel when towing another vessel shall, in addition to her side-lights, carry two bright white

lights in a vertical line one over the other, not less than six feet apart, and when towing more than one vessel shall carry an additional bright white light six feet above or below such light, if the length of the tow measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds six hundred feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in article two (*a*), excepting the additional light, which may be carried at a height of not less than fourteen feet above the hull.

Such steam vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Lights for Vessels Not Under Command.

ART. 4 (*a*). A vessel which from any accident is not under command shall carry at the same height as a white light mentioned in article two (*a*), where they can best be seen, and if a steam vessel in lieu of that light, two red lights, in a vertical line one over the other, not less than six feet apart, and of such a character as to be visible all around the horizon at a distance of at least two miles; and shall by day carry in a vertical line one over the other, not less than six feet apart, where they can best be seen, two black balls or shapes, each two feet in diameter.

Vessels Laying Telegraph Cables.

(*b*) A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as

the white light mentioned in article two (*a*), and if a steam vessel, in lieu of that light, three lights in a vertical line one over the other not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all around the horizon, at a distance of at least two miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes not less than two feet in diameter, of which the highest and lowest shall be globular in shape and red in color, and the middle one diamond in shape and white.

When to Carry Side-Lights.

(*c*) The vessel referred to in this article, when not making way through the water, shall not carry the side-lights, but when making way shall carry them.

(*d*) The lights and shapes required to be shown by this article are to be taken by other vessels as signals that the vessel showing them is not under command and cannot therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in article thirty-one.

Lights for Sailing Vessels Under Way and Vessels Being Towed.

ART. 5. A sailing vessel under way and any vessel being towed shall carry the same lights as are prescribed by article two for a steam vessel under way, with the ex-

ception of the white lights mentioned therein, which they shall never carry.

Portable Lights for Small Vessels Under Way.

ART. 6. Whenever, as in the case of small vessels under way during bad weather, the green and red side lights cannot be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than two points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

Lights Prescribed Respectively for All Vessels Under Forty Tons.

"ART. 7. Steam vessels of less than forty, and vessels under oars or sails of less than twenty tons gross tonnage, respectively, and rowing boats, when under way, shall not be required to carry the lights mentioned in article two (*a*), (*b*), and (*c*), but if they do not carry them they shall be provided with the following lights:

"*First.* Steam vessels of less than forty tons shall carry—

"(*a*) In the fore part of the vessel, or on or in front of

the funnel, where it can best be seen, and at a height above the gunwale of not less than nine feet, a bright white light constructed and fixed as prescribed in article two (*a*), and of such a character as to be visible at a distance of at least two miles.

"(*b*) Green and red side lights constructed and fixed as prescribed in article two (*b*) and (*c*), and of such a character as to be visible at a distance of at least one mile, or a combined lantern showing a green light and a red light from right ahead to two points abaft the beam on their respective sides. Such lanterns shall be carried not less than three feet below the white light.

"*Second.* Small steamboats, such as are carried by seagoing vessels, may carry the white light at a less height than nine feet above the gunwhale, but it shall be carried above the combined lantern mentioned in subdivision one (*b*).

"*Third.* Vessels under oars or sails of less than twenty tons shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

"*Fourth.* Rowing boats, whether under oars or sails, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

"The vessels referred to in this article shall not be obliged to carry the lights prescribed by article four (*a*)

and article eleven, last paragraph."—[Act of May 28, 1894.]

Lights for Pilot Vessels.

ART. 8. Pilot vessels when engaged on their station on pilotage duty shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed fifteen minutes.

On the near approach of or to other vessels they shall have their side lights lighted, ready for use and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side.

A pilot vessel of such class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the colored lights above mentioned, have at hand, ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

Pilot vessels when not engaged on their station on pilotage duty shall carry lights similar to those of other vessels of their tonnage.

Lights for Fishing Vessels.

ART. 9. (Article nine, act of August 19, 1890, was repealed by act of May 28, 1894, and article ten, act of

March 3, 1885, was re-enacted in part as follows, by act of August 13, 1894, and is reproduced here as article nine:)

Fishing vessels of less than twenty tons net registered tonnage, when under way and when not having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side lights; but every vessel shall in lieu thereof have ready at hand a lantern with a green glass on the one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

The following portion of this article applies only to fishing vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre:

(*a*) All fishing vessels and fishing boats of twenty tons net registered tonnage or upward, when under way and when not having their nets, trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

Lights for Vessels Fishing With Drift Nets.

(*b*) All vessels when engaged in fishing with drift-nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights shall be placed so that the vertical distance between them shall be not less than six feet and not more than ten feet, and so that the horizontal distance between them, measured in a line with

the keel of the vessel, shall be not less than five feet and not more than ten feet. The lower of these two lights shall be the more forward, and both of them shall be of such a character and contained in lanterns of such construction as to show all around the horizon, on a dark night, with a clear atmosphere, for a distance of not less than three miles.

Lights for Vessels Engaged in Trawling.

(*c*) All vessels when trawling, dredging, or fishing with any kind of drag-nets shall exhibit, from some part of the vessel where they can be best seen, two lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of such a character and contained in lanterns of such construction as to be visible all around the horizon, on a dark night, with a clear atmosphere, the white light to a distance of not less than three miles and the red light of not less than two miles.

Lights for Vessels and Boats When Line-Fishing, etc.

(*d*) A vessel employed in line-fishing, with her lines out, shall carry the same lights as a vessel when engaged in fishing with drift-nets.

(*e*) If a vessel, when fishing with a trawl, dredge, or any kind of drag-net, becomes stationary in consequence of her gear getting fast to a rock or other obstruction,

she shall show the light and make the fog signal for a vessel at anchor.

(*f*) Fishing vessels may at any time use a flare-up in addition to the lights which they are by this article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag-net shall be shown at the after part of the vessel, excepting that if the vessel is hanging by the stern to her trawl, dredge, or drag-net they shall be exhibited from the bow.

(*g*) Every fishing vessel when at anchor between sunset and sunrise shall exhibit a white light, visible all around the horizon at a distance of at least one mile.

Fog Signals for Fishing Vessels.

(*h*) In a fog a drift-net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag-net, and a vessel employed in line-fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog-horn and ring her bell alternately. [Art. 10, Act March 3, 1885.]

Light for Vessel Being Overtaken.

ART. 10. A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

The white light required to be shown by this article may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon

of twelve points of the compass—namely, for six points from right aft on each side of the vessel, so as to be visible at a distance of at least one mile. Such light shall be carried as nearly as practicable on the same level as the side lights.

Lights for Vessels at Anchor.

ART. 11. A vessel under one hundred and fifty feet in length, when at anchor, shall carry forward, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile.

A vessel of one hundred and fifty feet or upward in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than twenty and not exceeding forty feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it shall be not less than fifteen feet lower that the forward light, another such light.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel aground in or near a fair-way shall carry the above light or lights and the two red lights prescribed by article four (*a*).

Methods to be Employed for Attracting Attention.

ART. 12. Every vessel may, if necessary in order to attract attention, in addition to the lights which she is by these rules required to carry, show a flare-up light or use

any detonating signal that cannot be mistaken for a distress signal.

Special Lights for Squadrons and Convoys, and Private Night Signals.

ART. 13. Nothing in these rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal-lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by ship-owners, which have been authorized by their respective Governments and duly registered and published.

Day-Time Signal for Steam Vessel Under Sail Only.

ART. 14. A steam vessel proceeding under sail only but having her funnel up, shall carry in day-time, forward, where it can best be seen, one black ball or shape two feet in diameter.

Fog Signals for Vessels Under Way.

ART. 15. All signals prescribed by this article for vessels under way shall be given:

First. By "steam vessels" on the whistle or siren.

Second. By "sailing vessels" and "vessels towed" on the fog horn.

The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration.

A steam vessel shall be provided with an efficient whistle or siren, sounded by steam or by some substitute

for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient fog horn, to be sounded by mechanical means, and also with an efficient bell. (In all cases where the rules require a bell to be used a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.) A sailing vessel of twenty tons gross tonnage or upward shall be provided with a similar fog horn and bell.

In fog, mist, falling snow, or heavy rainstorms, whether by day or night, the signals described in this article shall be used as follows—namely:

(*a*) A steam vessel having way upon her shall sound, at intervals of not more than two minutes, a prolonged blast.

(*b*) A steam vessel under way, but stopped, and having no way upon her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between.

(*c*) A sailing vessel under way shall sound, at intervals of not more than one minute, when on the starboard tack, one blast; when on the port tack, two blasts in succession, and when with the wind abaft the beam, three blasts in succession.

Fog Signals for Vessels at Anchor.

(*d*) A vessel when at anchor shall, at intervals of not more than one minute, ring the bell rapidly for about five seconds.

Fog Signals for Vessels Towing and Being Towed.

(*e*) A vessel when towing, a vessel employed in laying or in picking up a telegraph cable, and a vessel under way which is unable to get out of the way of an approaching vessel through being not under command, or unable to manœuvre as required by the rules, shall, instead of the signals prescribed in subdivision (*a*) and (*c*) of this article, at intervals of not more than two minutes, sound three blasts in succession—namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

Sailing vessels and boats of less than twenty tons gross tonnage shall not be obliged to give the above-mentioned signals, but, if they do not, they shall make some other efficient sound signals at intervals of not more than one minute.

[Approved June 10, 1896.]

Speed of Ships to be Moderate in Fog.

ART. 16. Every vessel shall, in a fog, mist, falling snow, or heavy rainstorms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

A steam vessel hearing, apparently forward of her beam, the fog signal of a vessel the position of which is not ascertained, shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

Steering and Sailing Rules for Sailing Vessels.

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

ART. 17. When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other, as follows—namely:

(*a*) A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(*b*) A vessel which is close-hauled on the port tack shall keep out of the way of a vessel which is close-hauled on the starboard tack.

(*c*) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(*d*) When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward.

(*e*) A vessel which has the wind aft shall keep out of the way of the other vessel.

Two Steam Vessels Meeting End On.

ART. 18. When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other.

This article only applies to cases where vessels are

meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each vessel sees the masts of the other in a line, or nearly in a line, with her own; and by night, to cases in which each vessel is in such a position as to see both the side lights of the other.

It does not apply by day to cases in which a vessel sees another ahead crossing her own course; or by night, to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

Two Steam Vessels Crossing.

ART. 19. When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

Steam Vessels and Sailing Vessels Meeting.

ART. 20. When a steam vessel and a sailing vessel are proceeding in such directions as to involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel.

One Vessel to Keep Out of the Way.

ART. 21. Where, by any of these rules, one of two vessels is to keep out of the way, the other shall keep her course and speed.

NOTE.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision cannot be avoided by the action of the giving-way vessel alone, she also shall take such action as will best aid to avert collision. (See articles twenty-seven and twenty-nine.) [Act of May 28, 1894.]

One Vessel to Avoid Crossing Another's Bow.

ART. 22. Every vessel which is directed by these rules to keep out of the way of another vessel shall, if the circumstances of the case admit, avoid crossing ahead of the other.

Steam Vessel to Slacken Speed if Necessary, etc.

ART. 23. Every steam vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Vessel Overtaking Another.

ART. 24. Notwithstanding anything contained in these rules every vessel, overtaking any other, shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any direction more than two points abaft her beam—that is, in such a position, with reference to the vessel which she

is overtaking that at night she would be unable to see either of that vessel's side lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

Steam Vessels in Narrow Channels to Keep to Starboard.

ART. 25. In narrow channels every steam vessel shall, when it is safe and practicable, keep to that side of the fair-way or mid-channel which lies on the starboard side of such vessel.

Sailing Vessels to Keep Out of the Way of Fishing Boats, etc.

ART. 26. Sailing vessels under way shall keep out of the way of sailing vessels or boats fishing with nets, or lines, or trawls. This rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fair-way used by vessels other than fishing vessels or boats.

Special Circumstances Rendering Departure From Rules Necessary.

ART. 27. In obeying and construing these rules due

regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

Sound Signals for Vessels in Sight of One Another.

ART. 28. The words "short blast" used in this article shall mean a blast of about one second's duration.

When vessels are in sight of one another, a steam vessel under way, in taking any course authorized or required by these rules, shall indicate that course by the following signals on her whistle or siren—namely:

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going at full speed astern."

No Vessel, Under Any Circumstances, to Neglect Proper Precautions.

ART. 29. Nothing in these rules shall exonerate any vessel or the owner or master or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Reservation of Rules for Harbors and Inland Navigation.

ART. 30. Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbor, river, or inland waters.

Distress Signals.

ART. 31. When a vessel is in distress and requires assistance from other vessels or from the shore, the following shall be the signals to be used or displayed by her, either together or separately—namely:

In the Day-time.

First. A gun or other explosive signal fired at intervals of about a minute.

Second. The international code signal of distress indicated by N C.

Third. The distant signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball.

Fourth. A continuous sounding with any fog-signal apparatus.

At Night.

First. A gun or other explosive signal fired at intervals of about a minute.

Second. Flames on the vessel (as from a burning tar barrel, oil barrel, and so forth.)

Third. Rockets or shells throwing stars of any color or description, fired one at a time, at short intervals.

Fourth. A continuous sounding with any fog-signal apparatus. [Act of May 28, 1894.]

Conflicting Laws Repealed.

SEC. 2. That all laws or parts of laws inconsistent with the foregoing regulations for preventing collisions at sea for the navigation of all public and private vessels of the United States upon the high seas, and in all waters connected therewith navigable by sea-going vessels, are hereby repealed. [Act of August 19, 1890.]

AN ACT IN REGARD TO COLLISION AT SEA.

Each Vessel Shall Stand By.

The following act was passed by Congress and signed by the President, September 4, 1890. It will take effect on July 1, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that in every case of collision between two vessels it shall be the duty of the master or person in charge of each vessel, if and so far as he can do so without serious danger to his own vessel, crew, and passengers (if any), to stay by the other vessel until he has ascertained that she has no need of further assistance, and to render to the other vessel, her master, crew, and passengers (if any) such assistance as may be practicable and as may be necessary in order to save them from any danger caused by the collision, and also to give to the master or person in charge of the other vessel the name of his own vessel and her port of registry, or the port or place to which she belongs, and also the name of the ports and places from which and to which she is bound. If he fails

so to do, and no reasonable cause for such failure is shown, the collision shall, in the absence of proof to the contrary, be deemed to have been caused by his wrongful act, neglect, or default.

SEC. 2. That every master or person in charge of a United States vessel who fails, without reasonable cause, to render such assistance or give such information as aforesaid shall be deemed guilty of a misdemeanor, and shall be liable to a penalty of one thousand dollars, or imprisonment for a term not exceeding two years; and for the above sum the vessel shall be liable and may be seized and proceeded against by process in any district court of the United States by any person; one-half such sum to be payable to the informer and the other half to the United States.

Explanation of Storm Warnings.

Warnings of the approach of windstorms will be published by the display of flags by day and lanterns by night, in connection with the bulletins posted and the reports furnished to newspapers, mariners, and others interested.

The warnings adopted by the U. S. Weather Bureau for announcing the approach of windstorms are as follows:

The STORM WARNING (a red flag, eight feet square, with black center, three feet square) indicates that a storm of marked violence is expected.

The RED PENNANT (eight feet hoist and fifteen feet fly) displayed with the flags, indicates easterly winds, that is, from the northeast to south, inclusive, and that the storm center is approaching.

The WHITE PENNANT (eight feet hoist and fifteen feet fly) displayed with the flags, indicates westerly winds, that is, from north to southwest, inclusive, and that the storm center has passed.

When the RED PENNANT is hoisted above the Storm Warning, winds are expected from the *northeast quadrant;* when below, from the *southeast quadrant.*

When the WHITE PENNANT is hoisted above the Storm Warning, winds are expected from the *northwest quadrant;* when below, from the *southwest quadrant.*

NIGHT STORM WARNINGS.—By night a *red light* will indicate *easterly winds;* a *white* above a *red light* will indicate *westerly winds.*

The INFORMATION WARNINGS have been discontinued at all storm-warning display stations, and such advices as were previously given in information orders will be furnished hereafter in advisory messages.

The HURRICANE WARNING (two storm-warning flags, red with black centers, displayed one above the other) indicates the expected approach of a tropical hurricane or of an extremely severe and dangerous storm.

No night Hurricane Warnings are displayed.

NOTE.—The attention of captains is invited to the fact that at most regular Weather Bureau stations, by application to the Weather Bureau official, they may have their barometers compared. This service will always be rendered without compensation.

Signals Adopted by the Life-saving Service.

The following signals, recommended by the late International Marine Conference for adoption by all institutions for saving life from wrecked vessels, have been adopted by the Life-saving Service of the United States:

1. Upon the discovery of a wreck by night, the life-saving force will burn a *red* pyrotechnic light or a *red* rocket to signify: "You are seen; assistance will be given as soon as possible."

2. A *red* flag waved on shore by day, or a *red* light, *red* rocket, or *red* Roman candle displayed by night, will signify: "Haul away."

3. A *white* flag waved on shore by day, or a *white* light slowly swung back and forth, or a *white* rocket or *white* Roman candle fired by night will signify: "Slack away."

4. Two flags, a *white* and a *red*, waved at the same time on shore by day, or two lights, a *white* and a *red*, slowly swung at the same time, or a *blue* pyrotechnic light burned by night will signify: "Do not attempt to land in your own boats; it is impossible."

5. A man on shore beckoning by day, or two torches burning near together by night, will signify: "This is the best place to land."

Instructions for the use of
Capt. R. M. PUGSLEY'S CURRENT COURSE PROJECTOR.

Some navigators may prefer to count the degrees all on the bow and do away with the term—so many degrees abaft the beam in considering the current. If so the degrees may be so numbered with pen or pencil to suit the notion.

Currents.

A current is always named the same as a ship's course. That is, the course is named after the direction to which she sails. A current is named after the direction to which it sets or runs.

To use the current with this instrument, the direction from which it comes is to be considered.

1. Place the instrument on the chart table or any other convenient place.

2. Set the centre of the compass over the speed per hour of the ship.

3. Turn the compass card till the chart course is on the line marked SHIP'S SPEED per HOUR.

4. Move the arm till its center line cuts the current at its rate and angle. The center line on the arm will then cut the course to steer by compass to counteract the effect of the current.

5. Note the number of miles on the arm at the intersection of the center line of the arm, with the rate and angle of the current, and it will be the distance to run by log to equal the speed of the ship. See the following examples.

EXAMPLES.

The Current on the Starboard Bow.

Chart course is S. 5° W. The current sets N. 45° E., which is 40° on the starboard bow, at the rate of four knots per hour. The speed of the ship is fourteen knots per hour.

Find the course to steer by compass to make good the chart course and the distance to run by log to make good the ship's speed of fourteen knots.

Answer. Steer S. 14° W. by compass to make good the chart course S. 5° W. The distance to run by log to make good the ship's speed of fourteen knots per hour is 17⅛ miles.

The Current on the Port Bow.

Chart course is N. 20° E. The current sets S. 45° E., which is 65° on the port bow, at the rate of five knots per hour. The speed of the ship is eleven knots per hour.

Find the course to steer by compass to make good the chart course and the distance to run by log to make good the ship's speed of eleven knots per hour.

Answer. Steer N. 1° E. by compass to make good the chart course N. 20° E. The distance to run by log to make good the ship's speed per hour is nearly 14 miles.

The Current Abaft the Starboard Beam.

Chart course is W. The current sets S. 45° W., which is 45° aft of the starboard beam, at the rate of four knots per hour. The speed of the ship is twelve knots per hour.

Find the course to steer by compass to make good the

chart course and the distance to run by log to make good the ship's speed of twelve knots per hour.

Answer. Steer N. 73° W. nearly by compass to make good the chart course and the distance to run by log to make good the ship's speed per hour is a little more than 9½ miles.

The Current Abaft the Port Beam.

Chart course is S. 45° E. The current sets south, which is 45° abaft the port beam, at the rate of three knots per hour. The speed of the ship is seventeen knots per hour. .

Find the course to steer by compass to make good the chart course and the distance to run by log to make good the ship's speed of seventeen knots per hour.

Answer. Steer S. 53° E. by compass to make good the chart course and the distance to run by log to make good the ship's speed per hour, is a little more than 15 miles.

Instructions for using

Capt. R. M. PUGSLEY'S COURSE CORRECTOR.

The outside compass is to be considered true and the inside one the ship's.

Make the two compasses agree and if the variation or deviation are easterly, move the north point of the inside compass a corresponding number of degrees to the right. If the variation or deviation is westerly, move the north point of the inside compass a corresponding number of degrees to the left.

Make the center line of the arm cut the compass course on the inside compass and it will then cut the true course on the outside compass.

True courses are turned into compass courses by a similar operation.

EXAMPLE: Compass course S. W. by S. Variation 1° E. Deviation 4° W. Find the true course.

Make the two compasses agree and move the arm until the center line cuts 1° east on the outside compass, and move the inside compass until the north is under the center line of the arm. Now move the north point of the inside compass 4° west. The center line of the arm will then cut 3° east of north on the inside compass which shows an error of 3° westerly.

Move the arm until the center line cuts the course S. W. by S. on the inside compass and it will cut the true course S. 31° W. on the outside compass. See traverse table on page 34, CAPT. PUGSLEY'S GUIDE.

EXAMPLE: Compass amplitude W. 6° S. True am-

plitude W. 2° N. Variation 3° E. Find the compass error and deviation.

Make both compasses agree as before and then place the center line of the arm over the true amplitude on the outside compass, and move the inside compass until the compass amplitude cuts the center line of the arm. Then make the center line of the arm cut the true north, and it will cut the inside compass at 8° west of north. That shows a compass error of 8° E. Put the center line of the arm on 3° E. and move it to 8° E. That will be moving it 5° E. That is exactly what the ship did to the compass—moved it 5° E. which is the deviation. See example, March 26, 1902, on page 47, of CAPT. PUGSLEY'S GUIDE.

EXAMPLE: True azimuth N. 91° E. Compass azimuth N. 94° E. Variation 3° E. Find the compass error and deviation.

Make the center line of the arm cut the true azimuth on the outside compass, and move the inside compass until the center line of the arm cuts the compass azimuth. Then move the arm till the center line cuts the true north on the outside compass, and read the compass error on the inside compass as before. This gives the compass error 4° W. and the deviation 7° W. See page 50, CAPT. PUGSLEY'S GUIDE.

Important Notice.

The applicant for a license should have this instrument with him when he presents himself for examination, and use it for the purposes described above.

Form 941.

MONTHLY REPORT OF OFFICER IN CHARGE OF STEAMER CARRYING PASSENGERS FOR HIRE

Department of Commerce and Labor

STEAMBOAT-INSPECTION SERVICE

Port of ______________________________

______________________________, *190*

U. S. Local Inspectors,
Steamboat-Inspection Service,

Port of ______________________________

Gentlemen :

The following is a correct report, as required by Section 50, Rule V, Rules and Regulations of the Board of Supervising Inspectors, Steamboat-Inspection Service, for the month ended ______________________ 190 , for the steamer ______________________________

1. During the month the crew were called to quarters and exercised in unlashing and swinging out of the lifeboats, and in the use of the fire pumps and all other apparatus for the safety of life on board, and were drilled especially in the method of adjusting life-preservers and educating passengers and others in this procedure, on the following-named days and dates : *

____

____

____

2. Condition of Steamer and her equipment during the month : ____________

____

____

3. Total number of passengers carried during the month : ____________

____

(*Title* :) ______________________________

* NOTE.—If there was no call to quarters and drill at least once in each week during the month, the reason for such omission must be stated.

This report should be made only for the months during which the steamer was navigated.

Capt. R. M. PUGSLEY'S COURSE PROTRACTOR.
Price $1.00.

Why this instrument is superior to the parallel rulers or any other instrument heretofore produced to take their place.

1. This instrument can be conveniently placed on any part of a chart and set to correspond with the nearest magnetic compass, without having regard for the parallels of latitude or the meridians of longitude.

2. By the use of this instrument the difficulty, inaccuracy and danger due to the old method of using parallel rulers to plot a ship's position, transfer courses, etc., are eliminated altogether from chart work.

3. The results obtained by this COURSE PROTRACTOR can be quickly and conveniently verified.

4. This PROTRACTOR is more durable than parallel rulers, will outlast them and cost no more.

5. Every part of the instrument is transparent and therefore soundings, buoys, and all other matter on the chart are always visible under the instrument.

Instructions for the use of
Capt. R. M. PUGSLEY'S COURSE PROTRACTOR.

Place the center of the PROTRACTOR over the ship's position on the chart and move the arm until the center line cuts the center of the nearest compass on the chart, and note degree or point the center line passes through. Hold the arm in that position with one hand and turn the compass with the other, until the two compasses show the same point under the center line of the arm. The

PROTRACTOR compass now has the same variation as the chart compass.

Hold the PROTRACTOR compass with one hand and move the arm until the center line cuts the point to which the course is wanted. The center line on the arm will now cut the course on the PROTRACTOR compass which is to be steered by the ship's compass.

This instrument can be conveniently used to plot a ship's position by two or more bearings.

Take the bearings of the objects by the ship's compass. Place the center of the Protractor over one of the objects and set the compass to correspond with the chart as described above. Then move the arm until the center line cuts the course opposite the bearing, and make a dot at the end of the center line. Draw a light pencil mark from the object to the dot.

Place the Protractor over the second object and produce a second line the same way.

Where these two lines cross, will be the ship's position.

In plotting a ship's position on a Mercator chart by three or four bearings of different objects, do not expect all the lines to cross exactly at the same point as there must always be a slight difference in the higher latitudes.

For placing SUMNER lines on the chart and for finding the true azimuth from the lines of position, the PROTRACTOR will be very convenient to use for the purpose.

The length of the arm of the Protractor is about twenty inches, and if that is longer than is necessary for the chart on which it is used, a piece may easily be cut off with a heavy sharp knife or a chisel.

Instructions for the Use of

CAPT. R. M. PUGSLEY'S DISTANCE-OFF FINDER

Observe a bearing of the object when any number of points on the bow and note the time and log. After the bearing has changed about two points, note the time and log again.

With the dividers take from the scale at the side the distance run between the bearings and find the corresponding distance between the two bearings on a vertical line, and that line will indicate at the top the **Distance-off** the fixed object the ship will be when the object is abeam.

Example:

Course, N. N. E. and Barnegat light bears N., which is two points on the bow, and the log reading is seventy miles. After running eight and one-half miles, the same light bears N. N. W., or four points on the bow. With the distance run between the two bearings taken from the scale at the side with the dividers, find that distance on a vertical line between two and four points, and by the vertical line upon which it is found, the scale at top shows the ship will be six miles off when the object bears abeam.

CAPT. R. M. PUGSLEY

17 South Street New York City

Examples:

NORTHERN HEMISPHERE.—Storm track N. E. and the wind S. E. Then the ship is on the storm track and the STORM CARD gives the following directions:

If the wind changes to the southward, heave to on the starboard tack. If the wind changes to the eastward, run N. N. W. or heave to on the port tack.

SOUTHERN HEMISPHERE.—Storm track S. E. and the wind N. E. Then the ship is on the storm track and the STORM CARD gives the following directions:

If the wind changes to the northward, heave to on the port tack. If the wind changes to the eastward, run S. S. W. or heave to on the starboard tack.

If in either case the wind does not change, run on the course indicated on the proper card.

WINDS.

The term *Variable* has been defined in its general sense, or as compared to the terms *Constant* and *Periodical.* But, in Navigation, it is used in a special sense, that is, in designating and recording certain winds in the columns of the Log-Book. It is often misapplied, by seamen, to denote an *unsteady* wind, which, during the period of observation, may have veered and hauled through several points. In such cases the direction of the wind should be averaged to the nearest whole point. The term *Variable* should not only be used to designate very light airs flying all round the compass.

It was remarked by Lord Bacon and other writers, both in Europe and America, that the wind more frequently veers with the sun's motion, or passes round the compass in the direction of N., N. E., E., S. E., S., S. W., W., and N. W., to N. This follows in consequence of the influence of the earth's rotation in changing the direction of the wind. Dové has the merit of having, from Hadley's principle, propounded the *law of rotation of the wind,* and proved that the whole system of atmospheric currents, the permanent, periodical, and variable winds, obey the influence of the earth's rotation.

An important characteristic of winds is their quality, being dry or humid, warm or cold, according to their direction, and the nature of the earth's surface over which they have passed. Thus, in the northern hemisphere southerly winds are warm and moist, while northerly winds are cold and dry; and in the southern hemisphere *vice versa.* In Europe westerly winds are

moist and easterly winds are dry, while in North America northeasterly are cold and humid and northwesterly winds cold and dry.

MISCELLANEOUS.

Hot Winds of Deserts.—On the deserts of Africa and Arabia there sometimes prevails a wind extremely dry and intensely hot, which raises clouds of sand and transports it to a great distance. This wind is known in the desert of Africa and Western Asia as *Simoon* or *Simoun* (from the Arabic *samma*, signifying hot, poisonous, or anything disagreeable or dangerous), while in Egypt it is called *Khamsin* (Arabic for fifty), because it generally blows for 50 days, from the end of April to the time of the inundation of the Nile. This hot, dusty wind is felt in neighboring regions where it is known under different names. In Sicily, South Italy, and adjoining districts it is called the *Sirocco*. This wind is the plague of the Two Sicilies, and sometimes extends to the shores of the Black and Caspian Seas and to the steppes beyond the Volga. It is called the *Samiel* in Turkey, from its reputed poisonous qualities. The *Solano* of Spain is a southeast wind, which prevails at certain seasons in the plains of Mancha and Andalusia, particularly at Seville and Cadiz. This wind produces dizziness and heats the blood to an unusual degree. The *Harmattan* of Guinea and Senegambia belongs to the same class of winds. It is a periodical wind, blowing from the dry desert of Africa to the Atlantic, from latitude 15° north to latitude 1° south, during December, January, and February. It may be said of all these winds that their destructive effects on animal and vegetable life are due rather to their parching dryness, glow-heat, and choking dust than to any really poisonous qualities.

Peculiarities of Winds from Mountains.—The winds proceeding from mountains present many interesting phases, a few of which will be described. The *Pampero* is a wind which blows chiefly in the summer season from the Andes, across the pampas of Buenos Ayres to the sea coast. It is thus a northwest wind, or part of the anti-trade of the southern hemisphere. It is a dry wind, frequently darkening the sky with clouds of dust, drying up the vegetation of the pampas, and often extending to a considerable distance seaward. Some competent authorities assert that the dust which is brought to the shores of Southern Europe comes not from Africa but from South America. They arrived at this conclusion by making microscopic examinations of the sand or dust, in which were found certain organisms and dried infusoria which are known to exist only in South America.

This theory further states that the dust was elevated into the upper regions of the atmosphere, where it met a current from the southwest and was transported over 5,000 miles before it again fell to the earth.

PUNA WINDS.—To the eastward of Arequipa, in Peru, there is a barren table-land, between two great chains of the Andes, called the Puna or the Punos, which, for four months of the year is swept by cold, dry winds. These winds are part of the south trade-winds, which, after having crossed the lofty range of the Cordilleras, are cooled and parched to a degree that has perhaps no parallel in any other country in the world. The inhabitants, in traveling, find it necessary to protect their faces from the glare and heat of the day and from the intense cold of the night. The drying qualities of the Puna wind are so excessive that the bodies of dead animals exposed to it are very soon turned into mummies. Prescott states that it was in this district that the ancient inhabitants of Peru preserved their dead.

In the south of Europe north winds are notorious for their violence. The great differences of the temperature of the Alps, the Mediterranean, and Africa, explain them; and when the polar current, with high atmospheric pressure generally accompanying it, is descending at the same time over Europe, the effect is greatly heightened.

Of these winds the most noted is the *Bora*. This word seems to be a corruption of *Boreas,* though said to be derived from a Sclavonic term for "furious tempest." The Bora is greatly dreaded in the upper part of the Gulf of Venice, where it rushes down from the whole line of the Julian Alps with such irresistible fury that not only numbers of vessels are sacrificed but it ravages the shore also, being feared as much for the suddenness of its attack as for its violence. Entire districts are rendered nearly uninhabitable by the destructive effects of this wind on all vegetation. Its general direction is between north and northeast, and its most usual continuance about fifteen or twenty hours, with heavy squalls and terrible thunder, lightning, and rain at intervals. But the Bora most feared, and with justice, is that which blows in sudden gusts for three days, subsides, and then resumes its former force for three days more.

The *Mistral* (*maestral*) is the term applied by the country people to the northwest wind which sweeps from France down on the Gulf of Lyons. This wind is experienced in both summer and winter, though it is more violent and of longer duration in the latter season. In summer the mistral usually blows dur-

ing clear weather and seldom lasts more than twenty-four hours, while in winter it often lasts for several days and is accompanied by heavy rains. As a rule this wind blows hardest during the day, decreasing toward sunset, showing the direct effect of change of temperature in producing wind; for, during the day, the difference of temperature between the cold air of the mountains and the warm air over the sea is much greater than at night. These same winds prevail in the Gulf of Genoa and with equal strength, only that here, from the trend of the coast, they become N. N. E. in the middle of the Gulf.

The terrific squalls experienced in the Straits of Magellan, called by the natives *Williwaws,* undoubtedly owe their suddenness and violence to the great height of the mountains in that region (which are covered with ice and snow all the year) and to the corresponding differences of temperature of the air at such great elevations and that at the surface of the water.

PRACTICAL NOTES ON REVOLVING STORMS.

It is now generally conceded by all who have had opportunity for personal observation, and who have given sufficient attention to the subject of Ocean Storms, that the most severe gales met with at sea are what is commonly known as *Revolving Storms,* variously called by seamen HURRICANES, TYPHOONS, CYCLONES, &c., according to the locality in which they blow.

The distinctive characteristics of these storms are sufficiently marked to distinguish them from the ordinary straight-line gales that blow; and the following brief practical remarks are intended to assist and enable the Navigator who may not be familiar with the subject of revolving storms, to not only judge of the character of the coming gale, but also to take timely measures to avoid the dangerous part of it, either by heaving-to on the proper tack or by running away from it, as the case may be; and also, in particular cases where the track of the storm lies in the same direction as the ship's course, to take advantage of it and run along with it.

In the year 1831 Mr. William Redfield, of New York, after long and careful personal investigation and study of the subject, published a paper, in which he demonstrated that the gales on the American coast were whirlwinds and had a progressive or forward movement, traveling on curved tracks at a considerable rate, and were traceable from the West Indies along the coast of the United States, curving off to the eastward at some point between the Bermudas and the banks of Newfoundland.

Professor Dové. of Berlin, after investigating a number of

heavy gales that had attracted the attention of scientific men in Germany about the same time, came to similar conclusions regarding the character of those gales.

In 1838 Lieutenant-Colonel Reid, of the Royal Engineers, published a valuable work on the law of storms, in which he agreed in all particulars with the views of Mr. Redfield, having verified by personal observation all his theory. From investigations of storms in the South Indian Ocean, Colonel Reid further proved that the storms in the southern hemisphere revolve in the opposite direction to those in the northern hemisphere.

THEORY OF STORMS.—Upon the above standard authorities, and upon the recorded experience of a great many seamen whose reports are confirmatory of the Redfield theory, is based the assumption that the currents of air within the limits of the storm disc move in concentric circles around a center of low pressure, or, in other words, that the direction of the wind at any point within the storm disc is tangent to a circle the center of which is the storm center, and lies 90° (eight points) to the right, or on the right hand in the northern hemisphere, and 90° (eight points) to the left, or on the left hand in the southern hemisphere, supposing the observer to be facing the winds, as will appear by inspection of the accompanying storm cards.

EXCEPTIONS TO THE THEORY.—It is not pretended here to assert that this theory is absolutely true, or that the rule has no exception. To the contrary, the same experience that proves the theory also goes to show that the winds within the storm disc may, from various causes, be diverted from the circular course to any direction between the tangent and the radius of the circle, toward the center.

1st. *Proximity of Land.*—The *proximity of land* may generally be expected to affect the course of the winds in that part of the storm disc either in contact with it or under the influence of it, and may also, if the course of the storm is such as to strike a high coast at a considerable angle, so distort the entire storm disc as to render it difficult to determine the locality of the center from the direction of the wind; but if it be remembered that the effect of land upon a storm will always be to flatten it in, and thus bring the center nearer to the shore than the direction of the wind according to the circular theory would indicate, the Navigator may, even in such a case, by taking into account the character of the land and its distance from the

place of the ship, estimate sufficiently near the position of the center to take proper measures for avoiding it.

2d. *Local Disturbances.*—Temporarily, from ***local disturbances*** within the storm disc, for a full discussion of which the Navigator is referred to the standard works on storms, viz.: Piddington's Sailors' Hornbook, Reid on the Law of Storms, Dové's Law of Storms, &c.

Storm Problem.—The ***storm problem,*** considered only in its relation to the safe navigation of a ship at sea, is very simple, and may be briefly summed up under the following heads, which contain all that is necessary for a practical solution of it:

1st. Ascertain the character of the storm and locate the center.

2d. Determine the position of the ship in the storm disc, or the semicircle of the storm in which the ship is situated.

3d. Ascertain approximately the direction in which the storm is moving.

4th. Decide what to do with the ship to escape the center, or take advantage of the fair winds, as the case may be.

To ascertain the character of the storm, consult the barometer and the general appearance of the weather.

BAROMETER.

First.—The barometer generally indicates the approach of a storm by a restless oscillating motion of the mercury, caused by a disturbed condition of the atmosphere in the vicinity of a storm, and the consequent passage over it of atmospheric waves of different heights. These oscillations have been observed to vary from a just perceptible motion to 0.02 in.

Second.—The barometer often rises suddenly just on the border in front of a storm, by reason of the air banking up there, and therefore, if the clouds and general appearance of the weather indicate the approach of a storm, the rise in the barometer, if any occurs, is no guarantee that it will not come, but rather a sign that a severe storm is coming. (The barometer will probably not rise much in front of a slowly moving storm.)

Third.—A very rapid fall of the barometer after fairly entering the storm disc may be regarded as evidence of a very violent

storm of small diameter, and a gradual fall would indicate the contrary.

Fourth.—The following table, from Piddington's Sailors' Horn-book, page 252, may be of service in aiding the Navigator to decide how to act under peculiarly trying circumstances, where a risk has to be taken to save the ship, and when the question of distance from the center becomes the most important factor in the solution of the problem:

TABLE.

Average fall of barometer per hour:	Distance in miles from center:
From 0.02 in to 0.06 in	From 250 to 150
From 0.06 in to 0.08 in	From 150 to 100
From 0.08 in to 0.12 in	From 100 to 80
From 0.12 in to 0.15 in	From 80 to 50

Appearance of the Weather.—The indications of the approach of a cyclone do not differ materially from those of the ordinary gale; but a few such, as a hard steel-gray sky, or having a greenish tint, a blood red or bright yellow sunset, a heavy swell unaccounted for in any other way, and a thick lurid appearance of the sky, may be regarded in connection with a general threatening appearance of the weather, and particularly with a restless state of the barometer, as significant signs of a more than ordinary gale, and, whether seen separately or together, ought not to be disregarded.

Bearing of Center, North Latitude.—Having reason to suppose, from the action of the barometer and from the general appearance of the weather, that a revolving storm is near at hand, determine at once the bearing of the center. To do this, look in the wind's eye.

Then, if the ship is in the north latitude, the center bears eight points to the right of the wind point, or on the right hand, because in the northern hemisphere the currents of air within the storm disc move from right to left; that is, from north to west to south, and over east to north, &c., left-handed (in nautical parlance, *against the sun*), or in the opposite direction to the hands of a watch, looking at its face; and hence, at the north point of the storm circle the wind is east and the center bears south; at the west point of the storm circle the wind is north and the center bears east, always 90° or eight points to the right of the wind point.

Bearing of Center, South Latitude.—But if in south latitude, the center bears eight points to the left of the wind point, or on the left hand, because in the southern hemisphere the currents of air within the storm disc move from left to right; that is, from north to east to south, and over west to north, &c., right-handled (*with the sun*), or in the same direction as the hands of a watch, looking at its face. Hence, at the north point of the storm circle the wind is west and the center bears south; at the east point of the storm circle the wind is north and the center bears west, &c., always 90° or eight points to the left of the wind point.

Semicircles of Storm Disc.—The storm disc is divided into two equal parts by the line of the axis of the storm track, and the portion lying on the right side of this line (looking in the direction of the storm track) is termed the ***right semicircle,*** while the other half, or that portion lying on the left of the line, is called the ***left semicircle.***

In the right semicircle the change of wind will be to the right; that is, from north toward east, from east toward south, from south toward west, &c., and the first change of wind will therefore indicate that the ship is in the right semicircle. ***Then put the ship on the starboard tack.***

In the left semicircle the change of wind will be to the left; that is, from north toward west, from west toward south, &c., which will in like manner indicate that the ship is in the left semicircle. *Then put the ship on the port tack.*

The rule for the determination of the semicircle and the tack to heave-to on applies equally to all parts of the world; and if it be remembered that the name of the semicircle, the direction of the change of the wind, and the tack to heave-to on, all three correspond to the same side of a given line, we may reduce all that is necessary to remember, in order to place the ship in a safe position in the storm disc, to six words. Doing which, we should have:

For Right Semicircle.	"Right"....	(Semicircle).
	"Right"....	(Wind changes to the right).
	"Starboard"	(Tack to heave-to on).

For Left Semicircle,	"Left".....	(Semicircle).
	"Left".....	(Wind changes to the left).
	"Port".....	(Tack to heave-to on).

On the Storm Track Run Before the Wind.—A vessel directly on the track of the storm, or near it on either side would

not experience any perceptible change of wind, but would have a falling barometer and rapidly-increasing severity of the weather, if in front of the storm; and a rising barometer, with a gradual moderation of the weather, if in rear of the storm center.

If the ship be put before the wind and steered in one direction for a few hours, she will, if the storm be a revolving storm, change the wind, and reveal by this change the semicircle of the storm into which she has run.

To Ascertain the Direction of the Storm Track by Inspection.—In Piddington's Sailors' Hornbook, charts are found upon which are projected the tracks of a number of storms in the Atlantic and Indian Oceans and the China Seas, including the Bay of Bengal and a portion of the Pacific. An inspection of these charts will show that storms in particular localities generally travel in the same direction, and, ordinarily, the probable course of a storm may be found by inspection from one of these charts, the approximate position of the ship being known. But, as there is no absolute certainty that every storm will pass over the beaten track, no opportunity to verify the tracks on the charts or to ascertain by observation the approximate course of the storm should be neglected.

To Ascertain the Direction of the Storm by Observation

The approximate direction of the storm track may be found by plotting the positions of the ship and center on two or more consecutive bearings, using an estimated distance on the first bearing, and keeping an accurate account of the ship's way during the interval between the bearings. It follows here, as a matter of course, that the greater the angle between the bearings used the better the results obtained by this method.

To obtain satisfactory results from any of the foregoing methods of observation the ship should be hove-to. Having determined the position of the ship in the storm disc, and the approximate direction of the storm's forward movement on its track, the Navigator may intelligently so dispose his vessel as to incur the minimum amount of danger or reap the maximum attainable advantage, as the case may be.

If it be necessary to distance the center or to run out of the storm disc, the following rules should be observed:

Northern Hemisphere.

Right Semicircle.—Haul by the wind on the starboard tack and carry sail as long as possible; if obliged to heave-to, do so on starboard tack.

Left Semicircle.—Bring the wind on the starboard quarter. Note the direction of the ship's head and steer that course. If obliged to heave-to, do so on port tack.

On the Storm Track.

In front of the center.—Square away and run before it. Note the course and keep it, and trim the yards when the wind draws on the starboard quarter. If, however, obliged to heave-to, do so on port tack.

In rear of the center.—Run out with wind on starboard quarter, or heave-to on starboard tack.

Southern Hemisphere.

Right Semicircle.—Bring wind on the port quarter. Note the course and keep it. If obliged to heave-to, do so on starboard tack.

Left Semicircle.—Haul by the wind on the port tack. Carry sail as long as possible, and if obliged to heave-to, do so on port tack.

On the Storm Track.

In front of the center.—Run before it. Note the course and keep it, and trim the yards as the wind gradually hauls on the port quarter. If obliged to heave-to, do so on the starboard tack.

In rear of the center.—Run out with the wind on port quarter, or heave-to on port tack.

A rise in the barometer, improvement of the weather, and a gradual abatement of the force of the wind, will result from the above maneuvers; and the ship should in each case be kept on her course until by these signs it is made evident that she is out of danger.

All the above maneuvers depends, of course, on sea-room and the ability to carry sail. If sail can not be carried or land interferes the ship should be hove-to on the starboard tack in the Right Semicircle, and on the port tack in the Left Semicircle, and never otherwise.

A vessel lying-to on the port tack in the left semicircle in the Northern Hemisphere, and on the starboard tack in the right semicircle in the Southern Hemisphere, lies with her head toward the storm center, but there is no danger in this; as hove-to she will not head-reach to any great extent, and will therefore

not approach the center so as to endanger the safety of the ship. A vessel so disposed comes up to the sea with every shift of wind and will ride out the gale safely, whereas if she is on the opposite tack she is headed off by every shift of wind and will eventually bring the sea on the beam and quarter, in which position, even if she does not founder, she is certainly likely to receive serious damage from the sea.

A vessel finding herself in a favorable place in the storm circle may safely run along with the storm in the following positions:

To Profit by the Storm.

Northern Hemisphere.

1st. In rear of center on the line of its axis. Wind on port beam.

2d. Anywhere in the right rear quadrant. Wind on port side abaft the beam.

3d. Abreast and to the right of the center. Wind aft.

Southern Hemisphere.

1st. In rear of center on the line of its axis. Wind on starboard beam.

2d. Anywhere in the left rear quadrant. Wind on starboard side abaft the beam.

3d. Abreast and to the left of center. Wind aft.